THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR Susan Jill Rouse

TITLE OF THESIS Selected Effects of Progressive Relaxation Training on Female Gymnasts

DEGREE FOR WHICH THESIS WAS PRESENTED DOCTOR OF PHILOSOPHY

YEAR THIS DEGREE GRANTED FALL 1984

THE UNIVERSITY OF ALBERTA

Selected Effects of Progressive Relaxation Training on Female Gymnasts

by

(C) Susan Jill Rouse

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF PHYSICAL EDUCATION AND SPORT STUDIES

EDMONTON, ALBERTA

FALL 1984

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Selected Effects of Progressive Relaxation Training on Female Gymnasts submitted by Susan Jill Rouse in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY.

DEDICATION

This work is dedicated to those who helped me realize that
it is the process not the outcome that is the essence.

Abstract

It was the purpose of this study to examine the physiological, psychological, and behavioral effects of modified progressive relaxation (Peper and Williams 1981) on eight female gymnasts aged 19 to 21 years. A case study design using simple time-series data was employed to emphasize the idiosyncratic response pattern of each subject. The design was further sophisticated to designate three of the eight subjects as "modified experimental subjects", who were monitored physiologically, psychologically, and behaviorally, but received no unstressing training.

The fifteen week study consisted of eight weeks of unstressing training following a baseline period of six to twelve days, depending on the experimental group. Physiological monitoring of trapezius muscle tension, electrodermal activity and peripheral temperature was recorded during thirty minute testing sessions twice a week. The treatment was applied in the laboratory sessions. Self-reports measured the subject's perception of the intensity of unstressing felt before and after each session.

Simultaneously, performance on ten gymnastic skills was recorded twice a week in the gymnasium. Fifteen trials of each of the ten skills were videotaped and then scored for each performance testing session. A process of "progressive skill acquisition" was used, by which the skills increased in difficulty by altering the situational components. The subjects rated their personal stress level of each of the skills before and after the study.

The physiological, psychological and behavioral data were individually analyzed within each subject, and then integrated for discussion of the interrelationships that existed among the variables.

Results emphasized individual response patterns to the same stimuli. The self-report data were an integral part of the analysis, revealing personal anecdotes that added to the picture of the athlete as a "whole" person. The results were further discussed in light of coaching implications.

ACKNOWLEDGMENTS

To the members of my thesis committee, I would like to express my appreciation for their helpful hints, suggestions and constructive criticisms.
A very special thank you is extended to my chairman, Dr. Harvey A. Scott, for his unending moral support, assistance, and encouragement.

To the very special members of the Panda gymnastics team, who sacrificed many hours as subjects for this study, a sincere thank you for your dedication as subjects, and continuing friendships as people.

To my loving parents, appreciation for always supporting me in my endeavors.

And finally, to the many graduate students who have come and gone and special friends, whose friendships, sharing of ideas, and memories during my stay at The University of Alberta have made this an experience I will cherish always -- thank you.

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I. STATEMENT OF THE PROBLEM

A. Introduction

With the availability of improved facilities, equipment, more efficient learning aids and more advanced coaching and athletic training techniques, today's athlete faces fewer physical barriers in aspiring to be the best in her sport. With the increased availability of technical resources, the opportunity for the development of the physical factors (strength, flexibility, power, endurance and skill ability) becomes more realizable. Hence, it is the psychological aspects of performance that begin to distinguish between one athlete and another in terms of the consistency of her optimal performance. Differences in kinds and intensities of responses from person to person contribute to the difficulty of predicting human behavior. The coach is not striving so much to predict behavior, but instead to understand it and observe trends or patterns occuring over time.

Coaches are just now beginning to believe in and encourage the development of psychological training for their athletes. Previously, very little psychological education was made available to the athletes for various reasons, one being the lack of objectivity and consistency in the measurement and evaluation of psychological phenomena. As well, most coaches do not have sufficient knowledge in this area to systematically educate their athletes. Coaches have, however, come to believe that for the athlete to excel in sport, psychological skills must accompany the technical aspects and physical skills of the sport. A variety of individual differences and past learning experiences within a group of athletes can create difficulties for coaches who apply their coaching techniques in the same manner to all athletes, with expectations of the same positive performance results from all the athletes. These difficulties have encouraged coaches to evaluate the need for psychological training as a viable and beneficial supplement to the total athletic performance.

Prior to implementing a psychological training program for athletes, the researcher must evaluate the components of such a program to determine the physiological and

psychological effects on the athlete, as well as the behavioral effects on performance. The understanding of the *process*, not merely the *outcome* of the program provides the researcher and the coach with information regarding its efficacy as a benefit for the athlete. Coaches attempt to teach athletes using techniques that will produce the most consistent performance of skills. Similarly, a psychological training program that will be of most value to the coach is one which potentially provides athletes with the control to produce consistent and/or permanent changes in physiological and psychological variables which may influence performance.

Just as coaches need to understand the components of a physical training program prescribed for the athlete, attention must also be directed toward the psychological skills that influence the consistency of athletic performance. The athlete's mastery of control over these psychological skills results from learning what the active components of the skills are and how they influence the athlete's performance.

Researchers have identified four psychological skills which influence the athlete's consistency of performance (Martens 1980).

Emotional Control. Personal behaviors arising from anxiety, arousal, stress, and anger may negatively influence the athlete's performance progress unless she has the ability to control the behaviors to some extent.

Attentional Control. The athlete must learn to develop the flexibility to change attentional foci when situations demand it.

Self-Confidence Development. The development of this attribute encourages a strong "self", through which the athlete can better perform in any competitive situation. The mere nature of the athletic situation, emphasizing self-control and confidence, may inhibit the athlete from admitting her incapability to cope with a learning or performance problem.

Interpersonal Skills. The interaction between coach and athlete as well as among athletes is a contributing factor in optimal athletic performance.

These four skills cover a wide range of the total complement of psychological components and are susceptible to alteration through psychological training programs. The scope of this study

focused more specifically on one of these skills, *emotional control.*

Emotional Control

Inherent in athietics is the element of stress. Whether the athlete is learning a skill for the first time, practicing a skill to develop performance consistency, or polishing a skill to develop finesse, the path to achieve her goal is not always an easy and direct one. The athlete will inevitably face changes in intensity of fear, challenge, motivation, learning rate or kinesthetic awareness which will alter her rate of progress. At times, increased challenge and motivation will enhance performance.

> Challenge involves not only the judgment that a transaction contains the potential for harm *and* the potential for mastery or gain but also the judgment that this outcome can be influenced by the individual. (Holroyd and Lazarus 1982, p 23)

Research has shown that challenge and threat may elicit differing hormonal response patterns (Frankenhaeuser 1980). On the other hand, there will be times of injury, fear, failure or lack of understanding which will impede progress. Both positive and negative elements will inevitably arise within the athletic milieu. It has been theorized that an optimal level of these elements, specific to each athlete, enhances performance while an excess causes deterioration of performance. However, research has been inconclusive in recognizing a consistent method by which to determine an athlete's optimal level of tension and how to regulate it under competitive pressures.

There are many contributing factors from environmental and personality sources that influence behavior. As a result, research has changed its directional trend to accommodate process-oriented approaches that examine the interactions between the situation and the person, in hopes of developing a clearer understanding of the process that explains why individuals feel, think, and act as they do. The characteristics of the individual are the major mediating mechanisms between environmental stimuli and the responses they invoke. The psychological training programs that have been developed to teach athletes the necessary skills to cope with competitive situations, use multidimensional criteria of measurement to include cognitive,

physiological, and behavioral components. By examining the interdependent effect of these systems upon the individual, researchers can hope to better understand behavioral responses to various environmental situations.

> Three levels of stress analysis (physiological, social, and psychological) are to a degree independent, and they refer to different conditions, concepts, and mechanisms. The links between these levels are largely unexplored, tenuous and complex, primarily because they have not been studied within the same research design. (Lazarus et al. 1980, p 107)

Prior to examining measurement tools and theories, a clarification will be made as to what components are included under the title of *Emotional Control.*

A particular behavior may be conceptualized as varying along two dimensions: direction and intensity. The directional dimension is qualitative extending from positive to negative. The intensity dimension quantifies the magnitude of the behavior. It is this intensity dimension of behavior, affected by such components as arousal, stress and anxiety, that can interfere with the athlete's performance. Varying definitions of these constructs have resulted in the development of measurement tools based on different theoretical constructs (Reinking & Kohl 1975). In discussing arousal, stress, and anxiety as they relate to behavioral intensity of the athlete in this study, the following definitions will be used.

Arousal. Arousal refers to the physiological component of behavior manifested through responses of heart rate, blood pressure, muscle tension, etc. Duffy (1957) defined it as the degree of energy release varying along a continuum from deep sleep to high excitement. It is normally measured by a combination of peripheral, autonomic responses (muscle tension, skin conductance) and/or self-report measures (Landers 1980).

Stress. Stress occurs when there is substantial imbalance between environmental demand and response capability of the individual. This demand-capability imbalance becomes conscious through cognitive appraisal. Prerequisite assumptions necessary for stress to exist are:

(i) anticipation of inability to respond adequately to the perceived demand,

(ii) anticipation of negative consequences when response is inadequate, and

(iii) the consequences of failure to meet demands are perceived as important to the

individual (McGrath 1970).

Stress is not merely the stimulus or response, but is defined by the individual's perception of the event and appraisal of one's ability to cope.

Anxiety. Spielberger (1966) differentiates between two types of anxiety - trait and state anxiety. *Trait Anxiety* represents a relatively permanent personality characteristic reflecting past experiences that determine individual differences in anxiety proneness. *State Anxiety* is an emotional condition varying in intensity and fluctuating over time according to the situation. These two dimensions of anxiety interact to determine the effect of a stimulus situation. Insofar as behavioral expressions or performance deterioration is concerned, state anxiety and stress can be used interchangeably.

Stress and Sport

Athletes face competition even during practice sessions, whether it be against themselves or against peers. They strive for satisfaction while making comparisons of their performance with some standard of excellence in the presence of evaluative others (Martens 1980). The athlete is constantly appraising her progress toward the goal. Thus, there is ample opportunity for stress to interfere with this progress. The intensity of the stress as perceived by the athlete determines its effect on performance.

Martens (1980) introduced a Theory of Competitive Anxiety, which accounts for the interaction between the athlete and the environment in terms of four "stages". The *Objective Competitive Situation* is the actual situation faced by the athlete. How the athlete perceives that situation is the *Subjective Competitive Situation*. *Behavioral Responses* are evoked based on the previous two stages. These responses are elicited at three levels: behavioral, physiological and psychological. As a result of the responses, the athlete faces *Consequences* of the selected behavioral response, resulting in a reappraisal of the situation.

It can be seen that the athlete's interpretation of the competitive situation, (*Subjective Competitive Situation*), is a critical element in determining the intensity of her behavioral

response. Psychological training programs, sometimes referred to as stress intervention programs, are designed to teach the athlete greater control over emotional factors which influence her appraisal of the situation and consequently influence her athletic performance. A number of these stress intervention programs have been developed which use a combination of interventions (relaxation, imagery, breathing techniques, stress innoculation, biofeedback). Although clinical results reveal these programs to be effective, there is no clear scientific evidence as to the relative contribution of each intervention.

B. Statement of the Problem

Although there are conceptual and practical implications for stress reduction through intervention strategies at any of the four stages of Martens' theory, this study was designed to examine the effects of modified progressive relaxation training on the emotional factor of stress, as manifested in the intensity of responses of muscle tension, electrodermal activity and peripheral temperature. Progressive muscle relaxation was chosen for this particular study which used female gymnasts as subjects. Stress manifested in muscular tension can inhibit proper movement technique during gymnastic skill execution. It is hypothesized that during skill execution involving such precise motor coordination, there is a smaller range of optimal muscle tension. For this reason and the necessary controls implied by a research study, a treatment program consisting of progressive muscle relaxation was used in this study. The field experimental design called for the observation of the effects of this treatment on the components of Martens' stress model, (appraisal of the situation, behavioral responses and reappraisal), with the use of self-reports, physiological measurements and performance measurements.

The central purpose of this study was to determine what physiological, psychological and performance effects resulted from the implementation of a modified progressive relaxation training program (Peper and Williams 1981), one component of many psychological training programs for athletes. The indirect effect of the treatment (modified progressive relaxation) as

implemented in the training clinic, was assessed on performance of gymnastic skills.

C. Importance of the Study

It was hoped that the present applied research project would contribute significantly to both the theoretical and practical understanding of the process of developing psychological skills in athletes. It is well known that athletes face varying intensities of tension in every aspect of their athletic experiences. At times, the intensity is beneficial to performance. At other times, excessive stress or arousal levels cause problems for the athlete and coach. The literature in the area of arousal control argues that for consistent performance to occur, it is necessary that the athlete knows her optimal level of stress and be able to maintain it and change the intensity when the situation warrants it. The athlete must use various psychological skills to develop this control. Researchers and coaches are responsible to provide the athlete with the opportunity to learn these psychological skills. To select the proper skill to solve a particular problem, that problem must be defined in terms of the covert and overt detrimental effects it has upon the athlete. Effective use of a particular psychological skill implies that the researcher and the coach as well, know how it can affect the athlete cognitively, physiologically and behaviorally. It suggests that the athlete should be educated in a way that she becomes aware of these effects and sensitive to the implications of developing her own emotional control. The ultimate goal of this process is to give the athlete greater control over cognitive and emotional factors that can facilitate or block her performance.

In systematically observing the development of the athlete's awareness of and control over personal behaviors, applied or clinical research, such as that carried out in this study, will hopefully accumulate knowledge of the significance that individual difference factors play in the elicitation of behavioral responses. Discovering how the individual response systems and the mediating process of appraisal are organized and integrated within each individual as she attempts to adapt to the environment, will allow coaches to better understand and guide their athletes toward more efficient and consistent performance efforts.

Another intended contribution of this study was in drawing attention to the use of more efficient applied or clinical methodological tools with which to examine and modify human behavior in the field setting. Traditional research studying the relationship between human behavior and motor performance has been done in the laboratory using gross motor tasks. This design emphasizes controlling variables in order to isolate specific experimental dependent variables. In quasi-experimental studies, such as the present study, a natural setting was used, where "naturally occurring controls" were utilized in restricting the subject's behavior. Little evidence has been found that scientific results generalize from laboratory models to field settings, from behavior on motor tasks in the laboratory to behavior on motor tasks in the field, and from animal behavioral research to human behavioral research (Dishman 1983).

Field experiments, such as the present study, attempt to allow the subject to behave or react to various stimuli in a manner that as closely as possible resembles her behavior in the same non-experimental setting. The researcher has attempted to utilize "naturally occurring controls", and has implemented additional and necessary constraints that can be introduced without detracting from the *naturalness* of the situation. Although naturalistic field research may lack some degree of measurement precision and control, it is a valuable research methodology for increasing our ability to understand the relationship between individual emotional response systems and the mediating process of appraisal, and their organization within the individual in the "real world" setting.

The methodology employed in the present study involved the concommitant recording and analysis of three modes of subject data -- physiological, psychological, and motor behavioral. This integration or "triangulation" of observations on three different aspects of the same individual allowed a systematic look at the impact of the treatment effects on the athlete as a "whole" person. In this way, the researcher was able to relate changes in physiology and performance in light of self-reported perceptions of stress. This integrated approach to data collection has not often been used in the sport psychology field.

The methodological approach of a case study design in addition to using the three modes of measurement, allowed individual differences to be accounted for and weighted accordingly through the use of the self-report data. In addition, comparisons of data trends between persons can bring support to hypotheses which may increase our understanding of human behavioral changes. It was hoped that these methodological innovations would be useful in extending the knowledge of the field.

In conclusion, the results of this study were felt to contribute to research that focuses on the following.

1) The interrelationships of the various physiological response systems.

2) The importance of individual differences when examining the interrelationship between physiological and psychological behaviors.

3) The effect of an unstressing technique on the cognitive, physiological and behavioral parameters of each individual.

4) Methodological procedures such as a single case study design and self-report that emphasize the uniqueness of the individual subject in behavioral responses.

II. REVIEW OF LITERATURE

A. Introduction

It is the purpose of this literature review to examine the evolution of research on stress, anxiety and arousal, bearing in mind its application to sport. The vast amount of literature available in this area is tainted by a variety of terms used to describe the same construct. To overcome this, the terms upon which this study is based are presented in the beginning of Chapter III. The theoretical perspectives, from which the specific theoretical base for this study was derived, will lay the groundwork for the application of these theories to sport. The relevance of the theory to sport is explained through the physiological, psychological and behavioral responses to stress. Further discussion of stress responses will lead into some stress management programs available and specific measurement techniques of the stress response.

B. Theoretical Perspectives

Throughout the twentieth century, an enormous research effort has been conducted in the quest for understanding of human behavior. Unfortunately, without the sophisticated methodological tools of the past decade, different behavioral responses to the same stimuli were not considered to be interrelated. Thus, a variety of concepts for psychological phenomena were born, which in and of themselves were relatives of a common bond. Three of these concepts, *anxiety*, *arousal* and *stress*, were significant "terms" in various academic disciplines. Accordingly, different research interests were pursued which prolonged their separate existences. Now, as these divergent research thrusts begin to mature, common trends throughout each of the individual research efforts are being recognized as common hypotheses and theories differentiated primarily by semantical differences.

One of the first efforts to examine the relationship between arousal and motor performance was originally postulated by Yerkes and Dodson in 1908 which was based on

animal studies. The Yerkes-Dodson law indicated that task performance would improve as arousal increased when the task was a simple one. However, for more difficult motor tasks, the arousal level should be held reasonably low for optimal performance. This relationship between arousal and performance is referred to as the "Inverted U". The early notion behind this theory was that of energy mobilization during emotional situations -- that is, the idea of "fight or flight" mechanism (Duffy 1957).

A more recent explanation of the relationship between arousal and motor performance within the behavioral tradition was the Drive Theory, modified by Spence and Spence (1966). This theory predicts that *habit strength* and *drive level* jointly determine performance through a linear relationship. *Habit* refers to the hierarchical order or dominance of correct and incorrect responses. *Drive* is used synonymously with physiological arousal. According to this theory, an increase in drive would increase the probability of the dominant response being emitted. Whether an increase in drive will facilitate or impair performance depends upon the relative strength of any competing habits. Thus, if the habit strength of the competing incorrect responses are greater in relation to the correct ones, impairment of performance is expected with an increase in drive. As well, increased arousal during initial skill learning will impair performance but as the skill becomes well learned, increased arousal will facilitate performance (Farber & Spence 1953; Carron 1968).

Broen and Storms (1961) however, believe there is a ceiling effect for the level of reaction potential which is a joint function of drive and habit. Thus, increases in drive facilitate the elicitation of the dominant response to a point (ceiling). Thereafter, any further increase will elicit non-dominant responses resulting in performance decrements.

The difference between these two theories, the Inverted U and the Drive Theories, occurs when the subject's arousal level is high on a well-learned task. The curvilinear relationship supported by the Inverted-U hypothesis predicts increased arousal will impair performance, while the Drive Theory hypothesizes that it will facilitate performance.

Evidence of these theories in sport psychology has been reviewed by several researchers (Martens 1971; Martens & Landers 1974; Landers 1977). Methodological inconsistencies have been cited as a cause of inconclusive evidence in support of one theory over the other. For example, anxiety questionnaires have been used independent of any other instrument as a measurement tool for defining high-anxious and low-anxious subjects. As well, tasks used as performance measures have been various laboratory tasks in a controlled environment with little generalization to actual motor skill performance (Martens 1971). The major problem in attempting to apply the drive theory to motor skills is that it is difficult to define whether the correct or incorrect response is dominant. Thus, it is impossible to test the hypothesized relationship of Performance = Habit Strength x Drive (Martens & Landers 1969).

In the medical field, Hans Selye brought recognition to *stress* through his elaboration on the fight or flight response and subsequent development of the General Adaptation Syndrome (G.A.S.) (1936). Stress is "a set of nonspecific physiological reactions to any noxious environmental event". Selye's G.A.S. defines a systematic process through which the individual progresses when exposed to noxious stimuli. The alarm reaction upon initial exposure to the stimulus is followed by a stage of resistance during which adaptation to the stressor is attempted, resulting in the final stage of exhaustion if the stressor is sufficiently severe or prolonged. Selye's approach is a response based one, whereby it concentrates on treating the response as the stress or as its defining parameter. In applying this approach and attending mainly to the body's physiological responses to stressors, the psychological processes have taken a subsidiary if not silent role.

An alternative approach is that of stimulus-based models placing emphasis on the stimulus characteristics of the environment which were recognized as disturbing or disruptive. External stresses cause a stress reaction, or strain, within the individual. Based on engineering principles of stress, this model became popular because of its simplicity. Although applicable to machines, the model cannot hold up as a measure of human responses. Levine (1975) showed through his studies on animals that response to stress is partly dependant on the nature

of the organism's early environment. As well, there appears to be much too much individual variation in resistance to stress to be able to successfully apply a stimulus-based theory to explain human responses to stress.

During this evolution from response-based to stimulus-based theories, a similar movement was occurring in the field of psychology. Throughout the 1960's, personality theorists attempted to comprehend and predict performance using the individual's personality traits as the basis of their model (Kane 1964, Morgan 1972). The individual's traits purportedly cause generalized effects on behavior resulting in consistencies across situations. Over the years of research, very few significant consistencies have been found to link specific personality traits to improved performance.

In the early 1970's, another group of theorists banded together to find the link between situational variables and performance outcome (Mischel 1972). The situational model of behavioral variance views the relationship between the environmental stimuli and the responses to those stimuli as taking precedence over the subsidiary role played by personality factors. Their unproductive search succumbed to the hypothesis that there be an amalgamation of personality and situational variables as contributors to the outcome of performance. Thus, the interactionist theorists integrated the variables into an intricate system of modest interrelationships and complexities (Magnusson & Endler 1976).

Indicative of both of these theoretical perspectives, response-based/situation-based and personality/situation, is the common attempt to isolate or control for a small part of the human behavioral response. The unsuccessful attempts have prompted researchers to examine the integration of the components of these responses through more sophisticated theoretical models.

The resulting interactional models must carefully define the constructs, anxiety, arousal and stress, in relation to the dynamics of the particular model. An important ingredient in understanding the organization of behavior is recognizing the intervening psychological processes, particularly appraisal, that arise in response to threat and influence the reaction

pattern. The coping processes of dealing with stress and the underlying process of appraisal are fundamental assumptions of Lazarus' theory.

> The observed pattern of reaction depends on intervening psychological activities, such as the coping process. Underlying each type of coping is a particular kind of appraisal in which the consequences of cues are interpreted. This appraisal leads to the selection of a coping process. (Lazarus 1967, p 169)

Elaborating further on his theory, Lazarus (1970) cites two processes used to cope with threat or anticipated harm. One is to alter the organism-environment relationship. The other, the indirect method of reappraisal, is a continual searching for and evaluation of cues that the individual confronts.

Cox and Mackay (1982) have introduced a five stage transactional model of stress, drawing particular attention to its cyclical process due to the feedback components. "Stress is an individual perceptual phenomenon rooted in psychological processes." (Cox 1982, p 18) The first stage of this model distinguishes external from internal sources of demands placed on the individual. The second stage defines the individual's perception of the demand and her capability to deal with it. This perceptual factor allows for the presence of individual differences to influence the generalizability of the model. The third stage is the individual's psychophysiological changes that occur in response to stress. The actual and perceived consequences of these responses to stress, otherwise known as methods of coping, is the fourth stage. The last and most important stage is that of feedback. The feedback loop is an inherent part at each of the five stages, in that there is a constant reappraisal process occurring throughout each step of the model. When responses are ineffective or inefficient, stress will be prolonged. The feedback loops allow the individual to recognize this and effect changes at one or more of the stages. Stress is viewed as "a perceptual phenomenon arising from a comparison between the demand on the person and his ability to cope" (Cox 1982, p 25). It is the imbalance between demand and coping ability that results in experiencing stress and eliciting a stress response.

Three theoretical models that speak to this imbalance will be reviewed which have had particular relevance for athletes: (i) State-Trait Theory of Anxiety (Spielberger 1966), (ii)

Theory of Competitive Anxiety (Martens 1975), and (iii) Conceptual Model of Stress (Smith 1980).

It is generally recognized within the interactional theories that in addition to examining the extent of situational components, it is also imperative to evaluate these situations through the eyes of the individual. Some situations are much more anxiety-provoking to an athlete than other situations. In an attempt to clarify these discrepant, yet important individual perceptions, Spielberger (1966) defined two anxiety constructs; *state anxiety*, being a temporary emotional or reactionary condition, and *trait anxiety*, a relatively permanent personality characteristic. The premise of the theory is that persons high in trait anxiety tend to perceive a larger number of situations as threatening and respond with greater intensity of state anxiety to threatening situations than do persons low in trait anxiety (Spielberger 1970). Research has shown evidence to support this premise (Sarason 1960; Weinberg 1979; Scanlan & Passer 1978; Gruber & Beauchamp 1979; Wandzilak et al. 1982; Sanderson & Ashton 1981). This theory merely considers the psychological component of stress, omitting any interaction with physiological phenomena.

Martens (1975) elaborated on Spielberger's State-Trait Theory by incorporating into his theory an appraisal process. According to Martens' Theory of Competitive Stress, state anxiety is a function of the perception of danger of the situation. This threat is a function of the uncertainty of the outcome and the importance of the outcome to the individual. The principal component of this theory implies that the individual's perception of the athletic situation is encompassed by the degree of uncertainty and the degree of importance as evaluated by the athlete. Of the four theoretical components, Objective Competitive Situation, Subjective Competitive Situation, Responses (behavioral, physiological and psychological), and Consequences, there is consideration of the athlete's perceived demand/response discrepancy (Subjective Competitive Situation) and of her reappraisal through feedback from the consequences of the behavioral response. Martens (1977) developed the Sports Competition Anxiety Test (SCAT), a self-report questionnaire, to measure trait anxiety in a competitive

sport situation. Research shows that SCAT is a reliable predictor of state anxiety (Martens & Gill 1977; Gerson & Deshaies 1978; Martens et al. 1980; Wandzilak 1982).

Another model that parallels that of Martens' and was developed specifically as an educational program to enhance self-control and awareness in the individual, is the Conceptual Model of Stress (Smith 1980). Underlying this program are the reciprocal relationships between the situation, cognitive appraisal processes, affective arousal and behaviors. This cognitive-affective approach defines stress as "the emotional response of the individual to situations which tax the physical and/or psychological resources of the individual" (Smith 1980, p 2). The four major elements interacting within the model are: (i) the situation, (ii) the individual's cognitive appraisal of the situation, (iii) physiological arousal responses, and (iv) instrumental behaviors (task-oriented and coping behaviors). Smith & Smoll (1978) applied this theory through a stress management program for athletes. The results from this study supported the conceptual model in a decrease in measures of pre-game anxiety.

The basic components of these two theories (Martens' and Smith's) are similar. They are both based on a similar operational definition of stress, as a perceived substantial imbalance or misfit between the demand of the situation and the response capability of the individual. Important underlying assumptions to both theories are the importance to the individual of meeting the demand of the situation and the fact that there is a degree of uncertainty that one can meet the demand. The relevance of Martens' and Smith's theories for this study lies in their recognition of physiological responses as integral parts of the models. Although they are recognized, these theories do not propose to, nor do they attempt to, measure any physiological implications of stress that may occur in the competitive athletic situation.

C. Stress Response

In order to use any theories of stress, we must be able to understand what is involved in the response to stress. That is, when an athlete is confronted by a stressful situation, what specific types and intensities of response will occur?

> Whether or not stressors produce problems for the individual depends on a multiplicity of factors. In addition to the intensity of the stressors, their nature, range, frequency of occurrence and duration are important; the context or circumstance in which the stressors appear is clearly of significance; the perception of the degree of threat on the part of the individual is crucial as is his repertoire and utilization of adaptive coping skills." (Beech et al. 1982, p 10)

The stress experience is accompanied by a set of responses which are directed toward reducing or removing the stress. The three types of responses are physiological, psychological (cognitive) and behavioral. There is a critical interrelationship between physiological and psychological stress, that must be understood before proceeding with stress research.

Physiological Response

> Physiological stress has to do with the visceral and neuro-humeral reactions of man or animal to noxious stimulus agents and the physiological mechanisms that account for it...Noxious means any condition which is disturbing or injurious to tissue structure or function. (Lazarus 1967, p 162)

The tissue system is equipped with defenses against noxious stimuli. The source of stimuli is insignificant and the defenses or subsequent responses are nonspecific with respect to the stimulus (Selye 1956). Selye's general adaptation syndrome was based on this concept.

In an attempt to understand the physiology inherent in the stress response, it is necessary to be aware of the response systems involved. There are two primary systems, the central nervous system (brain and spinal cord) and the peripheral nervous system, which is further divided into the somatic system and the autonomic nervous system (ANS). The function of the ANS is to regulate the body's internal environment and maintain a state of homeostasis or balance (Guyton 1969). Although there are distinctions between the CNS and ANS, for the purpose of this discussion the emphasis will be on their relationship with respect to increased level of arousal.

Heightened activity in the ANS is thought to be initiated by cortical signals in the brain. These alarm signals activate the hypothalamus. The role of the autonomic nervous system is to control visceral functions of the body which include regulation of arterial pressure, sweat gland

activity, peripheral body temperature, cardiac output and tonus in skeletal muscles. Hypothalamic stimulation produces endocrine changes regulated by the pituitary gland. Thus, the hypothalamus via its control over the ANS, prepares the individual physiologically to engage in a particular behavior pattern (Bennett 1977).

Of the two divisions of the ANS, the sympathetic and parasympathetic, the former component is activated by hypothalamic activity. The sympathetic nervous system directs actions toward "strengthening the body's defenses against the various dangers which might beset it" (Cox 1982, p 52). Thus, it is an increase in sympathetic activation that is responsible for the emergency preparation of the body under stress. In this condition, observable changes that may occur include cooling of peripheral temperature of hands and feet, increased sweat gland activity, blood pressure, muscle tension and heart rate.

The influences of the parasympathetic system act synergistically to those of the sympathetic system. While parasympathetic stimulation to the sweat glands will cause a decrease in activity, sympathetic stimulation will cause an increase. In the autonomic effector organs which receive innervation from both components, a homeostatic balance is strived for.

It is important to recognize the relationship of the central nervous system to the sympathetic component of the ANS with respect to the stress condition. Although the stress response as a reaction to real physical danger has become generally maladaptive in today's world, Greenfield and Sternbach (1972) have proposed the possibility that this reaction is now psychologically oriented. Therefore, CNS influence in the form of cognitive mediators may be a precipitating factor. The close link between the CNS and ANS is also evident in the fact that while the hypothalamus controls the ANS, it is located in the brain and consequently is a part of the CNS. Thus, the hypothalamus seems to be an important structure in the systematic and complementary operation of the autonomic and central nervous systems. This functional balance may be responsible for any patterning or specificity that occurs in the stress response (Cox 1982).

Lacey and Lacey (1958) proposed that individuals exhibit idiosyncratic patterns of autonomic activity that can be reproduced from one stressor to another. Research showed low and insignificant correlations between measures of blood pressure, skin conductance and heart rate. However, they did find statistical evidence of interstressor reproducibility of autonomic-response patterns. Thus, several physiological variables were found to be a more reliable measure of the differential effects of various stimulus-conditions. For only a small percentage of the subjects did the physiological measures rise and fall together. The individuals maintained a pattern of differential activation peculiar to themselves. This *principle of relative response-specificity* speaks to "the hypothesis of quantitative individual differences in the tendency toward stereotypy of response-patterns" (Lacey & Lacey 1958, p 70).

Further research on response stereotypy has shown that there is a great dependence on environmental and individual factors which affect stress responses. The concept of *directional fractionation* of the response systems has yielded evidence of discordant directional changes in the sympathetic and parasympathetic response systems upon various physiological responses (Lacey & Lacey 1974).

A common physiological response to stress is increased muscle tension. The muscle has the ability to contract or shorten to produce movement. When a situation is interpreted as threatening, either physically or psychological, it rarely requires an all-out fight or flight response, but instead a preparation for action. Thus, the muscles contract but not to the extent that overt movement occurs. This incomplete or partial contraction constitutes a degree of muscle tension. "Muscle tension...is muscle contraction that is inappropriate or in excess: no work is done and it serves no purpose" (Girdano & Everly 1979, p 189). Just as the gross muscle movements can be controlled, so can the more subtle muscle tension once it is recognized. Clinical studies have shown that awareness of muscle tension can be learned (Whatmore & Kohli 1974).

For every physical or mental response, there is a required amount of effort or energy that must come from the individual. It is difficult to know what is the optimal amount of

energy expenditure necessary for a particular action. The answer lies in the degree of awareness the individual has of her own energy level. Whatmore and Kohli's theory of dysponesis (1974) examines the mechanisms necessary for efficient energy expenditure. *Ponesis*, derived from the greek root "ponos" meaning work or effort is

> the production of nerve impulses (action potentials) in pathways extending from motor and premotor cortical neurons through pyramidal and extrapyramidal tracts to and including the peripheral musculature. (Whatmore and Kohli 1979, p 380)

Correct signalling through this system encourages efficient energy expenditure, which will delay the onset of fatigue. When an error occurs in the signalling from the brain, the result is a dysponetic response.

> Dysponesis is basically a reversible physiopathologic state composed of errors in energy expenditure that interfere with nervous system function and thus with control of organ function...errors in energy expenditure within the nervous system. (Whatmore and Kohli 1979, p 379)

Whatmore and Kohli outline four effort classifications, under which various ponetic and dysponetic responses can be classified.

Bracing is one of the more common ponetic responses. A portion of or all the muscles are contracted and held in such a state for a period of time. Bracing is sometimes referred to as being "on guard" or prepared for "fight or flight". It is hypothesized that new sensory input can cause bracing. Another possible antecedent condition is the anticipation of an unpleasant sensory experience such as pain or loss of gravitational support. When a quick, vigorous overt action is about to be performed, bracing may occur. The excitatory effect of bracing causes hyperactivation of the reticular activating system, hypothalamus, and skeletal-muscular reflexes resulting in disturbances to nervous system functions.

Performing is represented by an overt skeletal muscle response. Activation of the hypothalamus and reticular activating system produce physiologic and biochemical support to complete the muscular movement. Dysponetic performing is evident whenever any overt behavior actually is working to the detriment of the individual. Skin rubbing or fidgety behaviors are forms of inefficient energy expenditure. Performing is often secondary to bracing, representing and attentional errors.

Representing is a process of activating tertiary sensory circuits which produce sensory images in the absence of the actual stimulus. Both visual and auditory imagery include such phenomena as thinking, remembering, anticipating and worrying. Dysponetic representing can take various forms:

1. *Re-representing* - repetitious representing of an unpleasant situation,
2. *Inaccurate representing* - forming unrealistic expectations,
3. *Flow error* - racing thoughts,
4. *Time error* - representing that interferes with on-going activities, and
5. *Goal representing errors* - setting vague, impractical, conflicting goals.

These types of dysponetic representing can be explained as either disorganized, hyperactive or inactive circuit activity.

Attention efforts facilitate the organization of input. Selective attention, being able to partial out unnecessary cues in order to attend to those most important ones, allows some input to have greater influence than other on the nervous system. Dysponetic attention is that contained excessively or for an extended time on one stimulus, while ignoring other types of stimuli. As well, there can be an excessive amount of shifting of attention from one cue to another. Excessive attention directed to exteroceptive input (environmental), interoceptive input, or representations can result in improper attentional focus for the required action.

The physiological basis of dysponetic behavior can help to objectify the "psyched out" state of the athlete. Several common examples of common dysponetic behaviors are:

1. tensing inappropriate muscles for a specific movement causing excessive energy expenditure, or excessive muscle activity in the appropriate muscle *(Bracing)*
2. rushing the execution of a skill causing inappropriate timing and coordination *(Representing: time error)*
3. anticipation and striving to do well *(Representing)*
4. imagining what could happen if the movement is not performed correctly *(Re-representing)*

5. attending excessively to nervousness (sweaty palms, nervous or muscular twitches, increased heart rate) *(Attentional error)*

Dysponetic responses are evident in situations where the individual "freezes up" thus inhibiting correct muscular movement from occurring. Muscular dysponesis can also take the form of tenseness in muscles that are not needed for that particular action. Although individual subjects may have responded more effectively to another muscle, the trapezius muscle was selected for electromyographic recordings in the present study due to its direct relevance to gymnastic performance. In gymnastics, the abundance of inverted body positions requires a great amount of shoulder elevation, depression, flexion and extension. The trapezius muscle, as a contributor to these actions, must be as efficient as possible. Although strength training programs aid in developing the strength of this muscle, if the muscle is too tense, it will not be able to work efficiently. For example, in a handspring vault where the muscular action of the shoulder girdle is critical, tense shoulder musculature will not allow a smooth and complete shoulder repulsion necessary for good performance of the vault. Because shoulder muscle action is so prevalent in every gymnastic event, it was hypothesized that the measurement of tension in the trapezius muscle would be helpful to the gymnast in recognizing specific muscle tension, the control of which may benefit gymnastic performance as well as alter dysponetic tendencies.

Psychological Response

It has been found that psychological stress must be communicated symbolically because the harm implied may only be anticipated, and yet, it must be recognized by the individual as dangerous to one's psychological well-being.

> The most important parallelism between psychological and physiological stress...both produce highly similar physiological reaction patterns. The most important difference is that physiological stress usually produces highly stereotyped responses through innate neural and hormonal mechanisms...Psychological threat is *not* invariably followed by a predictable response." (Lazarus 1967, p 166)

Stress has been viewed as producing a disruption of psychological equilibrium. Homeostatic

mechanisms are brought into play to reduce the stress. These mechanisms are referred to as coping mechanisms, which involve a reorganization of the usual pattern of behavior. If this reorganization is unsuccessful, behavior may become disorganized, resulting in abnormal behaviors (Cox 1982).

Unlike the overt physiological responses, psychological responses are more subtle making it difficult at times to categorize them as attributable to a specific stressor. The cognitive processes as well as coping processes are central features in understanding psychological stress responses.

> ...As a result of constant feedback and continuing efforts to cope with the situation or to regulate the emotional response, the person is also constantly reappraising his relationship with the environment, with consequent alterations in the intensity and quality of the emotional reaction. (Lazarus 1976, p 24)

According to Lazarus, there are two coping processes, *direct action* and *palliation.* In reference to stress as a misfit between environmental demands and the individual's ability to cope with those demands, one method of coping is to take *direct action* toward changing the individual's relationship with the environment. The individual can *prepare against harm* by reducing the actual danger or reducing its threat value. Direct action may take the form of *aggression,* in which the individual attacks the source of the problem. A third form of coping directly is through *escape* from the situation itself.

A more indirect form of the coping process is *palliation* in the form of reappraisal. The constant evaluation of incoming information and reappraisal of the relationship between person and environment gives rise to changes in the quality and quantity of psychological response.

In summary, the "stress response" can be viewed as a function of both physiological and psychological phenomena which include cognitive and affective processes, objectively and subjectively identified environmental factors, psychophysiological processes and behavioral processes (Everly & Rosenfeld 1981). Thus, it is a transactional process defined by the person-environment fit and the evaluation of the demand-capability paradigm by the individual.

D. Measurement of the Stress Response

From the previous literature review, a case has been made for using the physiological and psychological responses in a combined effort to determine the nature of the stress response pattern. This pattern in turn will help to identify through feedback the psychophysiological processes in use. A critical assumption in this process is the objective measurement of the various types of stress responses. Although the physiological measurement technique is more a question of what response is to be measured, measurement of the psychological responses presents crucial methodological difficulties in determining the nature and intensity of the response being measured.

Measurement of Physiological Responses

Three measurement techniques of the physiological response to stress that are applicable to this study will be reviewed: electromyogram, electrodermal response and peripheral temperature. One of the most commonly used physiological measures is electromyogram (EMG), the electrical activity accompanying muscle action (Basmajian 1967). Electrical impulses emitted by motor nerves innervate muscle fibers and consequently result in muscle contraction.

> Since muscular tension is proportional to the degree of electrical discharge stimulating the muscles, the EMG is a direct physiological index of muscular contraction or relaxation (the lower the microvolt level of EMG activity, the more relaxed the monitoring muscle). (Autogenic Systems 1975a, p 1).

Muscle tension has been the basis of stress reduction techniques for many years. At the base of Jacobson's theory of Progressive Muscle Relaxation lies the premise that muscle tension and stress are positively correlated. Thus, to reduce excess muscle tension, one must decrease stress by inducing a relaxation response (Jacobson 1938). From this theory, the field of biofeedback therapy has grown. Much of the biofeedback research has been conducted in clinical settings with implications for generalization into other areas of research. The most common mode of measurement is electromyogram, monitoring the frontalis muscle. This muscle was found to act as a generalized indicator of level of muscle activity in the total body

(Budzynski & Stoyva 1969). When working with clinical patients, overall body relaxation may be useful as a therapeutic measure. However, athletes need to be able to control certain muscles specific to the particular skill being performed. Electromyographic measurement of a specific muscle, such as the trapezius in the present study, would insure a more accurate training program for the athlete.

Dysponetic tendencies have been diagnosed through the combination of a detailed history of the patient and a physical examination using multichannel electromyometrography (EMMG) (Whatmore & Kohli 1974). EMMG measurement consists of obtaining statistical sampling of action-potential output from the skeletal musculature. Continuous measurement for ten to thirty minutes is taken from eight motor regions: flexors/extensors of ankle, flexors/extensors of wrist, masseter and frontalis. This treatment of dysponetic behaviors *orthoponetics*, concentrates on detecting and correcting physiologic signalling errors. The key to this particular successful treatment is the degree of awareness and control the individual is able to develop over covert ponetic signals recognized from the EMG feedback.

> ...the patient needs to learn a direct and precise control of minute quantities of action-potentials in both the <u>on</u> and <u>off</u> directions in order to correct dysponesis and obtain a high quality long-term result. (Whatmore & Kohli 1974, p 142)

Electrodermal activity (EDA) implies the electrical properties of the skin and has been used in the assessment of inappropriate emotional responses and arousal. The skin conductance level denotes the level of electrical conductance across the skin between two electrodes (Guyton 1969). Increased sweat gland activity is a common response of athletes when under competitive pressure and can be particularly dangerous in gymnastics where grip strength and foot placement are important parts of skill execution.

Lehrer (1978) found that progressive relaxation training significantly reduced the level of skin conductance. Other research has suggested that EDA is a physiological indicator of the level of cognitive activity (Schwartz et al, 1969; Kilpatrick 1972). They have also found that meditation has an effect on the change in electrodermal activity. This may explain the inconsistent findings on the effects of progressive relaxation on the EDA response (Simpson,

Dansereau, and Giles 1971).

Peripheral Temperature (TEMP) is closely associated with the sympathetic nervous system as are emotional responses. Activation of the sympathetic nervous system causes the smooth muscles to contract resulting in increased pressure on the peripheral blood vessels. The flow of blood to the area decreases, known as vasoconstriction, consequently resulting in decreased blood flow and decreased temperature during the stress response (Guyton 1969). Roberts et al (1975) found that there are substantial individual differences affiliated with developing awareness and control of peripheral temperature.

> It seems more likely that psychophysiological variables such as autonomic responsivity or lability, interpersonal variables such as attitude toward and relationship to experimenter, and attitudinal and motivational variables such as confidence are more likely to account for many of the observed differences in learning. (Roberts et al 1975, p 278)

Monitoring physiological variables in athletes is gaining recognition as a viable method to better understand their behavior when under competitive pressure. Wenz and Strong (1980) included EMG biofeedback training as part of an integrated approach to helping athletes overcome individualized performance stress responses. DeWitt (1980) subjected six university football players to a cognitive and biofeedback training program for stress reduction. EMG feedback sessions were found to have a significant effect on EMG levels in frontalis, masseter and trapezius muscles. A series of studies has been done to identify individual autonomic patterns by which marksmen's performance could be regulated (Daniels & Landers 1981; Landers et al. 1980). Using heart rate as the physiological variable, they found an important relationship between the timing of the trigger pull and components of the cardiac cycle. Weinberg and Hunt (1976) used EMG recordings to determine the relationship between level of anxiety and muscular activity for the overarm throw. Their results, based on continuous EMG recordings, revealed decreased accuracy with increasing levels of anxiety contributed to disturbed coordination between the agonist and antagonistic muscle groups. Fenz and Epstein (1967) combined self-report measures of stress with heart rate recordings to examine stress responses as novice and experienced sport parachutists prepared for a jump. Although both

groups were found to experience high levels of stress, the timing and subsequent coping processes of the two groups were different. The experienced parachutists were able to effectively cope with their stress level while the novice jumpers were not.

It can be readily seen from these examples of psychophysiological research efforts on athletes that there is a great amount of individual variation within the mode of measurement, the performance criteria and the research methodology used (Qualls & Sheehan 1981). These idiosyncracies must be accounted for and catered to when designing studies that involve psychophysiological measurements. Lacey, Bateman, and Van Lehn (1953) hypothesized the notion of autonomic response stereotypy, which emphasizes the general stress response style of each individual. If the individual's appropriate target response is identified, it may be possible to observe closer correlations between the psychological and physiological data.

Measurement of Psychological Responses

Measurement of psychological processes has always presented methodological problems and inconsistencies. Since a psychologically stressful situation is not always followed by a predictable response, researchers must rely on the subjects to relate their feelings. Standardized questionnaires and self-report measures have been used with reservation as to their reliability. However, in order to test the reciprocal relationships between cognitions, physiological responses and behaviors, a form of self-report must be part of the methodological procedures.

Self-reports have been used in an attempt to help the researcher understand the purpose of the research from the subject's point of view. Although the literature has not confirmed the correlation of self-reports with various dependent variables (Shedivy & Kleinman 1977), there continues to be an abundance of self-report measures used in research, especially involving multiple dependent variables (Sime & DeGood 1977; Reinking & Kohl 1975; Ravizza & Rotella 1981).

> ...verbal reports need to be looked at more seriously for what they can tell us about the interplay of cognitive, somatomotor, and physiological processes, particularly as it pertains to physiological self-regulation. (Shapiro 1977, p 222)

It has been hypothesized that self-report measures, behavioral observations and physiological measurements often proceed at very different rates (Beech et al. 1982). Thus, it becomes necessary to measure multiple and diverse response mechanisms longitudinally in order to increase the sensitivity of the total assessment procedure of the stress response.

Wolpe (1958) devised a self-monitoring instrument called the Subjective Anxiety Scale. It consists of an ordinal scale ranging from zero to one hundred, on which items are separated by subjective units of disturbance (SUDS). Hiebert (1976) substantiated the therapeutic value of SUDS. The results of this study showed that the level of stress perceived by the individual (as measured by SUDS) decreased after desensitization treatment was given to the subjects. Thus, cognitive understanding and increased awareness of reasons behind perceived stress levels aided in decreasing stress. Further research has been based on a modified stress thermometer similar to SUDS (Nye-Warren 1979). Based on this research, the self-report (SARP) used in this study was designed to measure the subject's stress ratings of the skill progressions.

The measurement of physiological and psychological responses is an important part of this study. Recognizing the underlying principles of the physiological response system confirms a need for control over which system, sympathetic or parasympathetic, is activated in each individual athlete. The implications of excessive stimulation of the sympathetic nervous system in the form of dysponetic tendencies have much relevance for the athlete. The uniqueness of the theory of dysponesis is that it implies psychological processes within behaviors (bracing, performing, representing and attentional efforts) and uses physiological variables (EMMG) to measure them. The combination of physiological, psychological and behavioral components is relevant to the hypothesized relationships of these components in the present study. The theoretical framework of this study is based on Marten's Theory of Competitive Stress with the inclusion of the dysponetic theory to elaborate on the role and measurement of physiological and psychological responses.

E. Management of Stress

Many stress management programs have been designed as means of helping individuals cope with stressful situations. Coping strategies may include cognitive restructuring (Lazarus 1972), autogenic training (Luthe 1969), self-instructional training (Meichenbaum 1975), biofeedback (Budzynski & Stoyva 1969), anxiety management training (Suinn & Richardson 1971), meditation and relaxation training to name a few. The rationale behind these strategies is to upset the chain of events that lead to the problem (Cox 1982). This break can be made by altering elements which contribute to the individual's appraisal of the demand and capability and of the consequences of coping. By restructuring the environment, changing the person's skill level or altering her perception of the situation, an interruption in the stress process can be made.

One method through which the individual's skills can be altered is relaxation. Progressive Muscular Relaxation (Jacobson 1938) teaches control of emotions through reduction of neural activity and contractile tension in striate skeletal muscles. The tense-relax method is founded on the principle that extreme levels of tension will allow the individual a better opportunity to recognize the opposite extreme, that of muscular relaxation. The condition of muscular relaxation is incompatible with the anxiety response (Budzynski & Stoyva 1972; Jacobson 1938; Wolpe 1958; Stoyva & Anderson 1982). Muscle relaxation has extensive effects on the autonomic nervous system, associated with parasympathetic activity, while muscle tension is associated with sympathetic activation. The CNS may be the initiator of muscular relaxation in the amount of effort signals emanated. Stilson, Matus and Ball (1980) concluded that "relaxation is not brought about mainly by a reduction of proprioceptive input from the peripheral skeletal-muscular muscle system to the CNS; rather, the critical feature seems to be the absence of effort signals from the CNS".

Joseph Wolpe (1958) utilized Progressive Muscle Relaxation as the basis of his technique, *Systematic Desensitization*, for treatment of phobias. After developing a hierarchy of anxiety-evoking stimuli, the subject utilizes the relaxation technique both before and during

exposure to the stimuli on the hierarchy. His research has given support to the principle that an individual cannot be relaxed and stressed simultaneously.

The technique of Progressive Muscle Relaxation is taught using a tense-relax method consisting of a series of isometric muscular contractions. The muscle group is tensed for six seconds and the individual "lets go" resulting in relaxation. Muscle groups are independently worked on in a sequential manner throughout the body. Jacobson refers to the method as "progressive" because the individual

1. learns progressively to relax the neuromuscular activity in the muscle,
2. progresses through the principle muscle groups until the entire body or a selected muscle group is relaxed, and
3. progressively develops a *habit of repose* as the technique is practiced over a period of time.
(Jacobson 1938)

It is important to emphasize that the practice of relaxation techniques represents a "skill", which can be obtained only through consistent and conscientious practice. It cannot be taught, it must be learned (Everly & Rosenfeld 1981). Jacobson (1938) maintains that progressive relaxation is designed to enhance one's awareness of muscle tension. In light of this, an increase in the awareness of muscle tension is purportedly associated with the reduction in one's resting level of muscle tension.

A modified form of progressive relaxation has been termed *unstressing* (Peper & Williams 1981). This method consists of four relaxation scripts, each of which emphasizes a particular aspect of the relaxation process. The term *unstressing* has particular relevance to the athlete, who may need to decrease her level of arousal but still maintain a certain amount of muscle tension for optimal performance. Thus, the treatment used in the present study was referred to as an unstressing treatment, and was based upon the four scripts outlined by Peper & Williams.

A study comparing the effects of progressive relaxation to those of hypnotic suggestion measured pre and post self-reported anxiety and four physiological variables (EMG, Heart

Rate, Skin Conductance and Respiration Rate) (Paul 1969). Results showed a significant difference between groups on all variables except skin conductance. The group subjected to progressive relaxation showed greater decreases in their perceived state of stress (self-reported), heart rate and muscle tension than the other group. The hypnotic group had greater reductions in respiration rate. The conclusion was drawn that progressive relaxation is a superior method of relaxation than hypnosis. However, the group design may have concealed contradictory results of the individual subjects.

Davidson and Schwartz (1976) suggest that the system, at which the relaxation technique is directed, will determine the effectiveness of the technique. Progressive relaxation, a somatically oriented technique has been found to produce reductions in muscle tension (Haynes, Mosley and McGowan 1975; Sime and DeGood 1977). Progressive muscle relaxation directs the individual into paying closer attention to the physiological sensation of increased or decreased muscle tension.

Sime and DeGood (1977) found that progressive muscle relaxation training produced significant decreases in frontalis EMG. Significance was found between these two variables in the group that received biofeedback training. Sime and DeGood suggest that the awareness of tension is somehow related to the ability to reduce EMG, but at this time, the relationship is not clearly understood. Conflicting results were found by Fee and Girdano (1978) who examined the differential effects of meditation and progressive relaxation on frontalis EMG. Their results showed that meditation but not progressive relaxation produced decreased muscle tension.

Budzynski and Stoyva (1969) hypothesized that subjective awareness of muscle tension is a by-product of and an intrinsic factor in bringing about a reduction in muscle tension. There have been very few studies that have revealed a correlative relationship between progressive muscle relaxation and subjective estimates of tension (Matthews and Gelder 1969). The researchers who have not found significance (Alexander, French and Goodman 1975; Lader and Matthews 1971; and Rachman 1968) suggest several reasons for these findings. One

is that the self-report is unrelated to EMG in subjects with minimal or no relaxation training. The training period must be intense enough and of a long enough duration that the subject is able to familiarize herself to the technique. Another explanation concerns the motivation of the subjects. Whether in the experimental or control group, subjects who are willing to cooperate optimally in the testing and training of the relaxation treatment have been shown to have an influence on the results (Alexander 1975; Alexander, Holland and Wallace 1976). The degree that these factors influence the results cannot be effectively measured or eliminated. Thus, these factors are possibly intervening variables that bias the research results.

Nideffer and Deckner (1970) showed improved performance of shot-putting following instruction in progressive relaxation and imagery. Using a case study approach and using a combined treatment of relaxation and imagery, the results cannot unequivocally evidence that progressive relaxation is an effective treatment by itself.

Kukla (1976) investigated the effects of progressive relaxation training on arousal and performance on baseball batting. Results showed lower post-test arousal scores (measured by Spielberger's State Anxiety Inventory, STAI) and better batting performance for the progressive relaxation group. These findings suggest that relaxation training enabled subjects to inhibit arousal reactions. Kukla hypothesized that a decrease in muscle constriction due to the relaxation training may have allowed subjects to act with more efficient motor responses. However, no physiological measures were taken to support this hypothesis.

Frager & Spector (1979) reported positive changes in swimming speed and improvements in attitude and concentration of swimmers subjected to a program of systematic desensitization and mental rehearsal. Training consisted of hypnotic induction, anxiety reduction and relaxation training, and cognitive rehearsal. Two case studies were cited as evidence of a positive effect of a combined psychological training program.

Most of the stress management training programs that have been designed for athletes incorporate some form of relaxation training as an initial stage. Smith (1980) uses a cognitive-affective approach based on his Conceptual Model of Stress. The intervention

strategy, induced affect, is directed at modifying cognitive mediational responses (appraisal) and the physiological arousal component of the model. The first step in this program is training in Jacobson's progressive muscle relaxation technique. Smith & Smoll (1978) conducted a stress management program with sixteen University of Washington football players. Results showed decreases on pre-game anxiety as well as improved game performance, evaluated by coaches. Suinn's Visuo-Motor Behavior Rehearsal, VMBR, (1977) emphasizes imagery rehearsal of performance. The athlete is trained to recognize physical-muscular signs of increased tension through imagery and then apply deep muscular relaxation to eliminate these tensions. The type of relaxation training used is dependent on the individual's need for increasing or decreasing arousal as well as individual biases towards cognitive or behavioral methods. Suinn (1976) used this program when working with Olympic skiers who successfully learned to image the correct behavior and use thought-stopping techniques when under competitive pressure. Spinelli & Barrios (1980) emphasize cue-controlled relaxation techniques in their Sports Psychology Training Package. After relaxation has been achieved, the athlete engages in self-statement modification aimed at replacing negative thoughts with task-oriented self-statements. Subsequently, visual-motor behavior rehearsal was used to focus the athlete's attention on specific motor sequences. A variety of cognitive and somatic skills were taught to athletes through the Cognitive Somatic Behavioral Intervention Program (Ravizza & Rotella 1981). This approach, designed specifically for university gymnasts, includes increasing awareness of anxiety, arousal and tension, further understanding the role of self-perception in defining situations as stressful, and learning various techniques such as cognitive restructuring (thought-stopping), relaxation, breath control and improvement of concentration. Training in progressive relaxation and imagery was done early in their program. Meichenbaum's Stress Innoculation Training (1975) involves educating the individual about the nature of emotion and stress reactions, learning physical relaxation techniques, rehearsing coping skills and then transferring these coping skills to the actual stress condition. The education of the athlete is one of the most important components of Martens' Psychological Skills Training Program

(1980). At each stage of the program, athletes are given information with which to understand the process in hopes that they may gain the control over internal responses. The Education Phase is followed by the Acquisition Phase, wherein athletes are provided with coping skills including relaxation training. In the final phase, the Practice Phase, athletes are guided to use the coping skills in an imagined competitive situation and then finally in the actual competition.

Underlying all these stress management programs are several themes. First, they attempt to educate the athlete in what stress is, the types of responses it effects, and a basic understanding of the stress process. Second, some form of relaxation training is taught to the athletes. Third, individual differences are recognized by offering a variety of coping skills to the athletes, from which each individual can choose the appropriate one that will facilitate adaptation in a wide variety of stressful situations. "There is a virtually limitless number of ways in which effective coping may manifest itself across situations and across persons" (Cameron & Meichenbaum 1982). Practically, this is necessary and the researcher should be open to the use of a multidimensional treatment model to better meet the idiosyncratic needs of the individual (Girdano & Everly 1979). However, for research purposes, it is impossible with more than one treatment, to be able to evaluate the success of one treatment over another.

F. Summary

The concept of stress has been researched for years. However, the variety of methodological and situational variables used in the research has made it difficult to draw conclusive evidence that generalizes across situations and populations. This literature review has touched upon several theoretical perspectives, from which sport research has drawn knowledge to expand the understanding of stress as it relates to athletes and their athletic endeavors. Discussion of research on the Drive Theory and the Inverted-U Theory relative to motor performance revealed equivocality. As a result, theories such as Speilberger's State-Trait Theory (1966), Marten's Theory of Competitive Stress (1975), and Smith's Conceptual Model of Stress (1980), were developed in an attempt to more clearly specify stress in the athletic

environment. These research attempts led into a quest for understanding the physiological and psychological implications of the stress response. Acknowledging that both of these components interact within the individual, a branch of the research efforts is examining the psychophysiological parameters of stress. Using a combination of physiological measurements (e.g. EMG, EDA, TEMP, Heart Rate) and psychological measurement tools (questionnaires and self-reports), stress management programs have been developed to help athletes become more aware of and better understand how to control their individual stress responses.

The research efforts today are exploring the feasibility and practicality of field studies, single subject designs and case studies to further understand the process of stress without detracting from the naturalness of the situation or the integrity and complexities of the individual athlete. A better understanding of how the individual athlete responds physiologically, psychologically and behaviorally to stressful competitive situations will enhance the coach's capabilities to help athletes achieve their athletic potential.

III. METHODOLOGY

Past research that has examined the effects of an intervention program on athletic performance has taken one of two approaches. The often used group design has unique drawbacks when used for this type of research. Group designs may present ethical problems by selecting one group, which will be denied the treatment in order to act as a control. The crucial influence of individual difference factors upon the effect of the treatment is considerably subdued by using a group design (Zaichkowsky 1980).

Some investigators have used a case study design to study the effects of one treatment on an individual's performance. 'Treatment packages' have been designed which combine several treatments to be applied to individuals or groups of athletes. Although results may show an improvement in performance, the evidence is insubstantial to attribute that improvement more to one treatment than to another. The effects of multiple intervention are cumulative and generally cannot be examined individually. Case studies yield large amounts of information about a single person but lack generalizability and therefore are rarely considered justifiable evidence for current research.

Although the case study is not without methodological constraints, it does allow the trends within one individual's responses to be evaluated without the influence of the other subjects' data. To allow the influence of individual differences to emerge as a critical element in the evaluation of treatment effectiveness, a case study time-series design was used in this study.

In the current study which used a case study design, eight subjects were introduced to an eight week *unstressing* treatment, during which their physiological responses were monitored in the laboratory. The treatment was continued on a daily basis at home in between the laboratory testing sessions. Simultaneously, performance data were collected on the subjects. Their performance on ten gymnastic skills was recorded for the entire fifteen week study to determine any effects of the treatment on performance.

A. Operational Definitions

Baseline - The period of data collection prior to the onset of treatment.

EDA - Electrodermal Activity as measured by Autogen 3400.

EMG - Electromyographic measurement of trapezius muscle as measured by Autogen 1700.

Learning Aids - Any alterations in gymnastic equipment specifications or physical environment which are implemented to increase the probability of correct skill execution.

Level - The mean value of the skill performance data within one experimental phase of the study.

Level Change - The change in the level of *physiological* response between the end of one experimental phase and the beginning of the next phase.

The change in level of the *performance* responses refers to an increase or decrease in the average level of response.

Matched Skills - For each skill on uneven parallel bars, there was an identical skill on balance beam (given apparatus physical restrictions). Skills A, B, C, D, and E on uneven parallel bars were matched to skills F, G, H, I, and J on balance beam.

Observational Data - Informative comments made by the subjects prior to or after the physiological testing sessions that were recorded by the researcher to be used in the explanation of idiosyncratic data points on a particular day.

Pre-Training - Within each physiological testing session, the period prior to administering the relaxation treatment.

Pre-Treatment - Baseline

Post-Training - Within each physiological testing session, the period after the completion of the relaxation treatment.

Post-Treatment - The testing days during the fifteen week study after the eight week treatment

had been completed.

Progression - A preparatory skill in a sequence of five or six skills executed on modified apparatus or in a modified environment to improve the probability of proper skill execution.

Progressive Skill Acquisition - The step-by-step sequences of skill progressions taken by the gymnast to progress from executing a gymnastic skill on the floor to executing the same skill on gymnastic apparatus at competitive specifications. The intermediate skills in the progression sequence involved some equipment or environmental modification.

Relaxation - Unstressing (Peper and Williams 1981), a modified form of Progressive Relaxation (Jacobson 1938).

RUS - Rating of Unstressing Sessions (self-report measure).

SARP - Stress Ratings of Skill Progressions (self-report measure).

Set - Five trials of one skill progression.

Slope - The rate of change of the physiological or performance scores within an experimental phase of the study.

TEMP - Physiological response of peripheral temperature as measured by BMT 302.

Treatment$_1$ - The first six days of performance testing after the beginning of treatment in the laboratory. (Used for analysis of the performance data.)

Treatment$_2$ - The period from the end of the treatment$_1$ phase of performance testing, to the end of the treatment phase in the laboratory. (Used for analysis of the performance data).

Unstressing - Relaxation through the application of a modified form of progressive relaxation (Peper and Williams 1981).

Unstressing Training - Four tape recorded sessions of modified progressive relaxation procedures implemented in four parts:

1) general unstressing;

2) recognizing slight amounts of tension;

3) unstressing specific to neck and shoulders; and

4) unstressing induced by cue words.

B. Experimental Design

The evolution of behavioral studies in human motor performance has revealed a trend toward research that observes the individual reacting in her natural environment. Laboratory studies using gross motor tasks have been criticized for their lack of generalizability to the "real" world using "real" measures of performance. In the transition from laboratory to field studies and from gross motor tasks to performance of fine motor skills, methodological problems have surfaced in reference to isolating specific experimental variables without implementing controls resulting in a fabricated "natural" environment.

The use of single case research designs in human behavior analysis has not been without criticism. Threats to internal validity, in particular, can lead to the influence of extraneous variables on the evaluation of the intervention and its effect on the dependent variable(s). A careful attention to and avoidance of the possible threats to internal validity (history, maturation, testing, instrumentation and statistical regression) (Kratochwill 1978), and how these can be reduced or eliminated, will allow the results of single subject research to produce valid inferences and "believable" contributions to further our understanding of human behavior.

Case study research that employs a time-series design emphasizes repeated measurement under baseline and intervention conditions. It has gained increased support as a viable method of analysis for behavioral research (Hartmann, Gottman, Jones, Gardner, Kazdin and Vaught 1980; Gregson 1983; Glass, Willson and Gottman 1975; Jones, Vaught and Weinrott 1977).

> Time-series research is the presence of periodic measurement processes on some group or individual and the introduction of an experimental change into this time series of measurement, the results of which are indicated by a discontinuity in measurements recorded in the time series." (Campbell & Stanley 1966, p 37)

In this type of design, the treatment is introduced to alter the target behavior while sequential behavior is observed across time. An effective treatment will show significant change in the dependent variables when the intervention is introduced. This design allows the researcher to observe individual differences to the effect of the treatment, which may differ from a group effect, exhibited in a typical pre-test/post-test group design (Zaichkowsky 1980). The case study design using time series data is considered "process" research because it continually assesses relevant parameters of the dependent variables during their measurement. "Outcome" research, using a group design, examines the end result as measured by the difference between starting and ending values of the dependent variables (Hatfield & Landers 1983). By assessing how the treatment affects individuals over a period of time, the case study time series design allows the researcher an opportunity to examine research questions by observing commonalities and differences among trends in the data for individual subjects. In any case, the critical point is to maximize the likelihood of demonstrating a particular relationship between the independent variable and the dependent variable(s).

> Interventions...do not have merely "an effect" but "an effect pattern" across time. The value of an intervention is properly judged not by whether the effect is observable at the fall harvest, but by whether the effect occurs immediately or is delayed, whether it increases or decays, whether it is only temporarily or constantly superior to the effects of alternative interventions.
> (Glass, Willson & Gottman 1975, p 5)

The research design used in the present study was a case study using simple time series data. A baseline period was used to assess behavior prior to intervention of the treatment. This baseline data was collected on the dependent variables (EMG, EDA, TEMP, and performance) across the three experimental groups (E 1, E 2, and E 3).

Data were collected on eight subjects for fifteen weeks from September 14 through December 22. Subjects were randomly assigned to one of three groups. The experimental groups (E 1 and E 2) received treatment after three weeks and six weeks of baseline, respectively. The implementation of the treatment for E 2 was delayed for three weeks to provide a control group (E 2) for a limited time. This *time-lagged control* design element demonstrated that any intervention effect that occurred was general across time (Glass,

Willson, & Gottman 1975). Measurement of physiological and behavioral variables were individually plotted for each subject on a time line extending from the beginning of the baseline phase through the end of the intervention phase. The effect of the treatment on the dependent variables was examined for each subject individually within her respective experimental group. The experimental design is illustrated in Appendix A.

During weeks one through three, baseline measures were taken on Group E 1. Treatment was administered from Weeks 4 through Week 11. Post-treatment measures were taken from Week 12 through Week 15. For Group E 2, baseline measures were taken from Week 1 through Week 6. Treatment was administered from Week 7 through 14. Post-treatment data was collected during Week 15. For Group E 3, data was collected under baseline conditions from Week 1 through Week 15.

Throughout the fifteen week study, physiological measures were taken two days/week for a total of thirty days of data collection. Simultaneously, performance on ten gymnastic skills was measured two days/week for the fifteen weeks.

Prior to the beginning of the study, the individual's perceived stress level of each of the skills to be used as performance criteria was measured. This self-report measure (SARP) was administered again at the end of the study. In addition to SARP, self-report measures were taken within the physiological sessions (RUS).

C. Subjects

The subjects were eight female intercollegiate gymnasts who were preparing to compete on The University of Alberta Women's Gymnastic Team during the 1982/83 C.I.A.U. season. The subjects volunteered to participate in this study. The skill level of these athletes was comparable to that of the 1981/82 qualifiers of the Canadian University National Gymnastic Championships. The subjects' ages ranged from 19 to 22 years. Subjects were randomly

assigned to one of the three experimental groups:

Group	Subjects
Experimental Group 1 (E 1)	1, 2, 3
Experimental Group 2 (E 2)	4, 5
Modified Experimental Group (E 3)	6, 7, 8

These groups were designated specifically to reduce threat to internal validity due to history.

D. Treatment

The unstressing procedure used in this study was based upon modifications of the original form of Progressive Relaxation (Jacobson 1938) and Modified Progressive Relaxation (Peper and Williams 1981). The researcher made further minor procedural modifications within the text to emphasize the bond between the unstressing technique and its application to the performance variable in this study (Appendix B).

The relaxation procedure was referred to as *unstressing* (Peper and Williams 1981). In gymnastics, reference is often made to 'staying tight' during execution of skills. Consequently, the term 'relaxation' may have presented a contradiction for the gymnast, especially when used prior to skill execution.

The unstressing procedure was divided into four parts, each of ten minute duration. The procedure for each part of the treatment was recorded on a cassette tape. The particular emphasis of each part of the procedure was:

Tape 1 - Unstressing of the isolated muscles in the body using a basic tense-relax procedure.

Tape 2 - Learning to recognize slight amounts of muscle tension throughout the body.

Tape 3 - Unstressing specifically muscles in the neck and shoulder areas while recognizing varying levels of tension.

Tape 4 - Unstressing by using cue words during verbal description of a specific skill.

Each subject in the experimental groups (E 1 and E 2) listened to the tape twice a week in the laboratory while simultaneously being monitored physiologically (EMG, EDA, and TEMP). In addition to the treatment twice a week in the laboratory, subjects were instructed to listen to the tape once each day that they were not scheduled in the laboratory. Each tape was used in chronological order for two weeks of the eight week treatment period. The experimenter deliberately made no mention to the subjects of applying the unstressing procedure to the gymnastic skills measured in the gymnasium.

E. Physiological Variables

Measurements on three physiological variables were taken on each subject during each laboratory session:

1. (EMG): Electromyographic measurement of the right trapezius muscle,
2. (EDA): Electrodermal response measured from the fingers of the dominant hand, and
3. (TEMP): Peripheral temperature from the second finger of the non-dominant hand.

Instrumentation

All physiological measurements and treatment sessions were conducted in a laboratory containing equipment to monitor physiological responses. Battery checks and calibration of all equipment were made prior to the testing session of each subject. All wired connections and electrode leads were also examined for any faulty parts.

An Autogen 1700 electromyographic unit was used to monitor muscle tension from the trapezius muscle. Double-sided adhesive electrode disks were attached to each of three silver/silver chloride electrodes. After Hewlett Packard electrode gel was applied to each electrode, they were placed on the skin surface covering the subject's right trapezius muscle.

The skin had previously been rubbed with an alcohol swab. Electrode placement was carefully determined at each session, complying with the instructions and diagrams in the Autogen 1700 procedure manual.

The BFT 302 feedback thermograph unit monitored peripheral temperature from the second finger of the non-dominant hand. The thermistor was secured to the finger with a piece of tape according to procedures in the BFT 302 operating manual.

An Autogen 3400 electrodermal unit monitored electrodermal activity from the fingers of the dominant hand. The skin of the fingers was cleaned prior to electrode placement to avoid interference from excess skin oils. Two active and one ground nickel-plated electrodes were attached to the palmar surface of the fingers of the dominant hand. The two active electrodes were attached to the second and third fingers. The ground electrode was attached to the index finger. A velcro strip allowed the electrodes to be securely attached.

An Autogen 5600 integrator, connected to the Autogen 1700, 3400, and a printer was programmed to yield a print-out of all EMG and EDA measurements immediately after each session. Manual recording of these data was also done in case of equipment failure or any gross movement by the subject. Temperature data were recorded manually by the researcher.

Treatment sessions, accompanied by physiological monitoring, were conducted in the same laboratory. The treatment was administered via cassette tape played on a Sony cassette tape recorder. The treatment tapes were recorded on cassette tapes by the researcher.

Data Collection

<u>Baseline</u>

For subjects in all three groups, *baseline measurements* of the three physiological variables were taken using identical procedures. All subjects were required to be inside the building for a minimum of thirty minutes prior to their laboratory testing session to reduce any interference from weather conditions on physiological functioning. The subject and experimenter were seated next to each other in the laboratory. The subject was seated in a

straight-back chair with her back to the equipment. The TEMP thermistor, EMG electrodes and EDA electrodes were attached to the subject. After each piece of equipment was attached to the subject, the power for that piece of equipment was turned on to allow monitoring stabilization to begin. During the stabilization period of a minimum of five minutes, the subject sat quietly. This length of time was sufficient for the subjects to achieve physiological stability. A table lamp with a 100 watt light bulb replaced the overhead lighting during each session. The subject was told to sit comfortably and quietly for five minutes. When all three physiological meters had stabilized, the data collection was started. Visual readings were recorded every fifteen seconds for each of the three modalities. Recordings of physiological measurements during each baseline session were taken for a total of five minutes. Within each five minute session, five one-minute averages and one five-minute average were obtained from the integrator. These measurements were referred to as *baseline measurements* during the baseline phase and *pre-training measurements* during the treatment phase of the study. After five minutes, the integrator began printing out the session information, the thermistor and electrodes were removed from the subject and the session was concluded.

Baseline measurements were taken on all subjects twice each week for the fifteen weeks of the study. Laboratory sessions for each subject were at a consistent time throughout the fifteen weeks, (i.e. at the same hour and on the same days each week).

Pre-Training

Treatment sessions were administered for eight weeks to the five experimental subjects in Groups E 1 and E 2. Immediately at the conclusion of the five minute *pre-training measurements*, the tape recorded treatment was begun.

Post-training

At the conclusion of the tape-recorded treatment, the subject was asked to sit quietly for five minutes. During this period, the same recording procedure as that of the baseline phase (five one-minute measurements and one five-minute measurement on all physiological variables) was completed. These measurements were referred to as *post-training measurements.*

Post-treatment

After the eight week treatment was concluded, subjects continued to be measured on the physiological variables until the end of the fifteen weeks, using the same procedures as those used in the baseline phase. These measurements were referred to as *post-treatment measurements*.

Self-Report

All experimental subjects were asked to rate their stress levels immediately before and after each treatment session, including those sessions outside of the laboratory. The Rating of Unstressing Sessions (RUS) consisted of a ten-point scale which was labeled as follows:

0---10

Most unstressed you have ever been	Most stressed you have ever been

Subjects were instructed to complete the scale immediately after the unstressing session by circling one number on the first scale denoting their stress level before listening to the tape and circling one number on the second scale denoting their stress level after listening to the tape (Appendix C).

F. Data Analysis

Visual Data Analysis

A common method for analyzing time-series data in case study designs has been visual analysis through graphical representation. The purpose of determining an experimental criterion is to best examine the effects of intervention at various points over time (Kazdin 1982). Visual inspection allows the researcher to judge the degree of reliability and consistency of the effects of the intervention. Kazdin (1982) defines several characteristics of the data, upon which visual inspection depends. These pertain to the magnitude of the changes across phases and the rate of these changes.

1. *Changes in mean* reflect shifts in the average rate of behavior between phases.
2. *Changes in level* show a discontinuity of behavioral intensity from the end of one phase to the beginning of the next, demonstrating whether or not the intervention produces reliable changes.
3. *Changes in trend* reveal tendencies of the data toward systematic increases or decreases over time.
4. *Latency of change* is shown in a delay in behavior change after the initiation of treatment.
5. The *variability of responses* within a particular phase is of particular importance to the present study.

Other considerations include the duration of each phase, the consistency of effects across phases and reliability of the data assessment.

> Visual inspection is conducted by judging the extent to which changes in these characteristics are evident across phases and whether the changes are consistent with the requirements of the particular design. (Kazdin 1982, p 237)

Concerns about visual analysis of data have been brought out with respect to its ability to draw unequivocal results from the effects of an intervention. One criticism is the lack of concrete rules to be used to determine the range of a reliable effect. "The process of visual inspection would seem to permit, if not actively encourage, subjectivity and inconsistency in the evaluation of intervention effects" (Kazdin 1982, p 239). Another weakness of this method of data analysis has been that it regards only very marked changes in behavior as significant. Thus, a variable which does not produce large changes in behavior may be discarded without being given another chance to test its effect. Visual analysis requires particular data patterns in baseline and treatment phases to interpret results accurately. If a trend exists or baseline data is unstable, it is difficult to visually analyze the effect of the intervention.

Statistical Data Analysis

Statistical evaluation of behavioral data has been proposed as a supplement to or replacement of visual analysis (Kratochwill 1978; Parsonson & Baer 1978; Kazdin 1982). The critical problem with using statistical methods on behavioral data, especially single case designs,

is violation of the assumptions which underlie the statistical tools (Kratochwill 1978). There are, however, several circumstances when statistical analysis can be of valuable use in determining reliability and consistency in changes of behavior. When data reveal an unstable baseline, statistical methods can determine whether the intervention effect has occurred over and above what would be expected by continuation of the baseline trend (Kazdin 1982). Statistical analysis has been found to be useful when behavior variability within subjects is high and visual analysis of the data cannot pick out significant changes. Even when the intervention causes undramatic changes, statistical evaluation may distinguish that degree of change as significant and consistent.

The use of the t-test and F-test within single case designs threatens the violation of the assumption that data points are independent, having uncorrelated error terms. Serial dependency, when data are significantly correlated, is fairly common in time series data. That is, data from day 1 is likely to predict data from day 2, etc. (Jones, Vaught & Weinrott 1977). This factor is accounted for within the Program for Analysis of Time-Series Experiments (TMS) designed by Bower, Padia, and Glass (1974). The time-series experimental design can be described as one in which a series of observations of a variable are recorded over time, into which an intervention has been introduced. Its purpose is to compare baseline and intervention phases to determine the significance of any change in level and trend of the dependent variable from one phase to the next. The TMS program analyzes the data through two stages. The first stage identifies an appropriate stochastic model as a result of a partial autocorrelational analysis, to determine the degree, if any, of serial dependency within the data. The second stage applies the model to the data to perform a least-squares theory analysis on the intervention effects.

Time-series analysis is not applicable to all single case designs. The analysis depends on a large number of data points within each experimental phase. This is necessary to determine the existence and pattern of serial dependency in the data. Without this information, it is difficult to select the appropriate model for the data. However, when data reveals baseline

trends, large degree of variability, or slight changes in the effect of intervention, time-series analysis can statistically analyze the data for changes in trend or level.

> Thus, time series analysis and experimental manipulation together are needed to answer questions concerning what sort of system is functioning when the internal structure is not directly observable.
> (Gregson 1983, p 23)

Treatment of the Data

The physiological data was visually analyzed to determine any differences between pre-training and post-training measurements within subjects. Pearson product-moment correlation coefficients were calculated between the difference scores (pre-training minus post-training) of each pair of physiological variables to determine any relationships. A cross-tab matrix was computed to compare self-reported measures of relaxation with the pre-training to post-training physiological differences. A time-series analysis (Bower, Padia & Glass 1974) was computed to determine any trend or level changes in physiological data of the baseline and pre-training phases, as a result of the treatment application. In consideration of the clinical importance of some of the less powerful changes in the data, the criterion level for significance in this study was set at $p < .05$.

G. Performance Variables

Selection of Skills

Ten gymnastic skills were used as performance variables. Five were uneven parallel bar skills and five were balance beam skills. Each skill was divided into five or six progressive stages, each stage representing a skill in itself [1]. The following criteria were used to select appropriate skills for the purpose of this study.

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[1] It was necessary to break down Skills C and H into six progressions. Each of the other eight skills were divided into five progressions. Thus, there was a total of fifty-two skill progressions.

1. All skill progressions were considered to be "whole skills"[2].

2. The ten skills were paired across the two gymnastic apparatus used in this study (uneven parallel bars or balance beam) as follows:

Skills

Uneven Parallel Bars		Balance Beam
A	--	F
B	--	G
C	--	H
D	--	I
E	--	J

The matched skills are as similar as possible given the physical characteristics of each apparatus[3]. Skills were matched to decrease the performance bias of any subject for one apparatus over the other apparatus. Another reason for skill matching was to compare performances on matched skills within subjects to denote any similar performance patterns over time.

3. Each skill was partitioned into several progressive stages (skill progressions) (Appendix D). The first progression of each skill was the whole skill on the floor. The last progression of each skill was the whole skill in the actual performance environment.

4. The subjects had not attempted all progressive stages of the skills. Some subjects had attempted the first progressions of several of the skills. Ability levels on all skills were assessed prior to the study (Appendix E {Part B of SARP}). Each subject started at progression one of each skill.

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[2] Skills can be taught in their entirety or parts of the skill can be practiced separately and then combined as the whole skill. This is referred to as whole learning method or part learning method, respectively. All skill progressions used in this study are considered whole skills, as they consist of the entire skill performed under different situational conditions.
R. N. Singer, Motor Learning and Human Performance. London: The MacMillan Company, 1969, pp 213-16.

[3] One of the uneven parallel bar skills (Skill A) uses the element of swing around the bar. This element cannot be simulated on the balance beam.

5. The step-by-step progressions within each skill were designed to vary according to changes in the situational environment. The whole skill was performed in the first progression of each skill. Using the gymnastic apparatus and specific learning aids, the situational environment was sequentially changed for each skill progression until the final skill progression was reached, in which no learning aids were used.
6. These ten skills were chosen as skills that were applicable to the subjects' performance level and potential. These skills could potentially have been used in the gymnasts' routines during the 1982/83 competitive season. All ten skills were rated as "B" or "C" difficulties in the F.I.G. International Code of Points for women's gymnastics.
7. Besides being rated as difficult moves, all of these skills contained a degree of risk in their execution[4]. Thus, the risk factor increased the likelihood that the skill would characterize a "stressful situation" for the subjects.

Data Collection

Skill performance was tested two days each week for fifteen weeks. Subjects were present at one of two scheduled testing times each day. A maximum of four subjects were tested at any one session. Subject order during the session was random. The sequence of skills for each skill testing session was rotated daily to nullify the effect of muscle fatigue on the performance of any particular skill, (e.g. Skill A was the first skill to be tested on Week 1, 5, 10 and 15). As well, uneven bar skills were tested first on day one of each week and balance beam skills were tested first on day two of each week.

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[4] "Courage, daringness, possibility of point loss by missing an element with risk in an exercise that has been built up to achieve bonus points...elements with free flight and several turns around the longitudinal axis or horizontal breadth axis or movements which require a high degree of strength, coordination, balance, etc." International Code of Points for Women, pp 15-16.
The risk factors inherent in the skill progressions were: increased height of the performer off the ground, executing the skill over an obstacle such as a rope or an uneven rail and decreased size of landing area. One or more risk factors were evident in the progressions of each skill.

For subjects who missed a testing session, a make-up session was conducted either later that same day or on the following day. If the subject could not attend the make-up or could not perform due to injury, data for those skills were considered missing for that testing session.

On the first day of baseline testing, each subject began with the first progression of each skill. On any testing day, each subject executed ten skill progressions, one for each of the ten skills. Each subject performed three sets of five trials of each skill progression totaling fifteen trials per day of each of the ten skill progressions. All subjects in the testing session completed the first set, then set two and finally set three.

Skill A

Subject	Set 1 (5 trials)	Set 2 (5 trials)	Set 3 (5 trials)
1			
2			
3			
4			

The number of trials each week of one skill progression totaled thirty.

Equipment and Facilities

The performance testing sessions were held in the women's gymnastic room at The University of Alberta. A JVC 1/2" video camera and monitor were used to film all the testing sessions. The camera was placed in a position which provided the best angle for analysis of the skills. The types of apparatus, abbreviations, and specifications of the equipment are listed in Appendix D.

Measurement of Skill Performance

Each skill progression was measured on a scale from 0 to 10 points. In accordance with the 1979 F.I.G. Code of Points for judging women's gymnastics, the errors were evaluated as small, medium or large. Errors for each skill progression were specified according to correct

technique and execution. The performance scores were defined from zero to ten as follows:

0 - Balking: no attempt at skill execution
1 - Unsuccessful attempt; less than 50% completion of the skill
2
3
4
5 (Specific scoring criteria for scores of 2 through 9
6 were defined for each skill progression.)
7
8
9
10 - Successful performance without technical or execution errors

Interobserver Reliability

When behavior is scored or evaluated by human observers, there is need to provide a reliability check to insure "agreement between observers who independently score the same behavior of a subject" (Kazdin 1977, p 141). It is necessary to distinguish between *agreement* and *accuracy* when referring to observational reliability. Agreement refers to how closely the observers' scores correspond. Accuracy, on the other hand, determines whether the observers' scores reflect the subject's actual behavior. The general assumption that underlies methods of interobserver reliability is that if the agreement percentage is high, the observers' scores are probably reflective of the true behavior (Kazdin 1977).

There are several factors that can influence and bias the scoring procedure: observer drift, observer expectance, complexity of observations, complexity of coding instrument, and specificity of definitions within scoring criterion (Kazdin 1977). Observers may inadvertently over time change the way they analyze behaviors, resulting in variable scoring criteria. Observer drift can sometimes be caused by the expectancy of a certain behavior due to previous performances of the subject. When the complexity of the observed performance or the complexity of the criteria with which it must be evaluated is too great, there is an increased chance of misrepresented behavioral assessment.

To eliminate any negative influence of these factors on the assessment of performance within this study, the following procedures were used. All scoring of performance was done

from a videotape monitor outside of the gymnasium. A slow-motion and stop control allowed the observers to be more accurate in their assessments of the performances. The performances of the skills were scored by the researcher as well as one other observer, a U.S.G.F. rated gymnastic judge who was unfamiliar with the subjects. The researcher scored all the performances during the fifteen week study. The external observer scored eight of the thirty sessions in a random order to decrease any observer expectancy or drift due to past performances of the subjects. The scoring criteria for each skill were designated according to judging rules set out by the International Federation of Gymnastics as well as the progressive nature of the skills[5]. These written criteria with illustrations for each of the ten possible points for each skill progression were available to observers for reference at each scoring session. The skills performed were basic skills to gymnastics, with which the trained eye of a gymnastics judge would be familiar. Due to the fact that skills on balance beam were matched with those on uneven parallel bars, some of the scoring criteria were also matched across skills decreasing the number of different movements the observer would be evaluating.

Three methods of estimating observer agreement are discussed in the literature (Kazdin 1977; Kelly 1977; Hartmann 1977; Kazdin 1982). Trial reliability or point-by-point agreement assesses observer agreement on each behavioral instance. "Trial reliability is important in most behavioral studies, but particularly so in those studies in which analyses are performed on trial data" (Hartmann 1977, p 108). The second method is interval recording or frequency ratio. This method uses the total number of observations in an interval of behavioral recordings, denying the importance of observations of each individual behavior. The third method is reliability through a correlation coefficient. This method is based on paired scores by the two observers for each skill within each session.

The research on interobserver reliability defines behavior recording in terms of frequency or duration. Thus, recordings can be made using the tally, duration, or interval

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[5] The progressions for each skill were designed in a manner that the gymnast after mastering one progression could proceed to the next progression with a fairly good chance of performing adequately on the new progression. That is, the progressions were designed to eliminate large gaps in transition from one progression to the next.

method. However, for continuous, non-interval data, as were the performance data in this study, these methods of evaluation were inapplicable. An agreement percentage was calculated between the two observers' performance scores, as reported in Table 1. This method of determining interobserver agreement was more stringent on the type of data analyzed in this study. Therefore, since the agreement percentages were 85% or higher, with the exception of three instances, this method was believed to be an adequate measure of the degree of interrater reliability.

Criteria for Skill Progression Advancement

The skill progressions were designed as sequential stages of improvement. As the performer improved her skill execution, she proceeded to the next skill progression. Consistent performance at a level of minimal execution errors had to be achieved in order to move on to the next skill progression. These criteria were followed:

1. During one testing session, the performance score had to be in the range between 8.0 and 10.0 points on a minimum of 50% of the trials.

2. During the next testing session, the same skill progression had to again be executed at the criterion level (8.0, 9.0, or 10.0 points) on the first two trials.

    a. If the subject was successful, she proceeded to the subsequent progression.

    b. If unsuccessful, she continued to execute the previous progression for the remainder of the trials during that testing session.

Until the criterion level, as stated in #1, was again attained during another testing session, the subject continued executing the same skill progression.

Self-Report

The stress ratings of skill progressions (SARP) (Appendix E) was developed by the researcher for the purpose of determining the degree of stressfulness within each of the skill progressions used in this study. It was designed after Wolpe's SUDS (Subjective Units of

Table 1
Percentage Agreement Between Observers

Skill	Day 1	2	3	4	5	6	7	8
1	90.83	92.31	94.12	90.76	89.83	93.27	90.00	85.33
2	82.50	91.67	89.17	89.52	90.48	93.27	87.78	85.33
3	86.67	86.55	88.24	86.67	86.67	86.67	86.67	88.33
4	86.67	86.67	93.33	90.83	87.50	90.00	90.00	92.22
5	95.00	93.33	94.12	93.33	91.67	92.50	91.67	94.29
6	91.60	91.67	89.17	91.67	85.83	91.67	94.17	90.00
7	93.33	95.00	94.17	90.83	94.17	85.00	95.00	97.14
8	77.50	89.52	89.93	89.92	87.50	92.05	89.33	86.67
9	90.00	84.87	87.50	87.50	88.33	89.17	89.52	90.00
10	95.83	96.67	95.83	95.83	95.83	95.83	95.00	94.29

Disturbance) (Wolpe 1958). The underlying rationale was for the subject to outline stressors in a hierarchical order which was then used to desensitize the subject of the intensity of perceived stress for each item of the hierarchy.

SARP was divided into three parts. The first part yielded demographic data (i.e. name, age, gymnastic affiliation, and level of competition). In the second part, the subject was asked to rate on a six point scale her present ability level on the ten skills specific to this study. Each number on the scale was assigned a description of ability states ranging from A - "never tried this skill", to F - "can consistently perform this skill with the beam or bars at regulation height and without padded equipment or spotters, on 8 out of 10 trials". In the third part of SARP, the subject rated her stress level immediately prior to attempting each of the fifty-two skill progressions.

The skill progressions were hierarchically ordered. For each one, the subject was required to select a level of stress on a scale ranging from 0 (low stress) to 9 (high stress), that corresponded to her perceived level of stress for that skill. Each subject completed the SARP before the beginning of the study as a pre-test measure. She completed it again after the conclusion of the study as a post-test measure of stress levels on the skill progressions.

The SARP questionnaire was administered as a pilot to a group of competitive gymnasts of differing ages and ability in order to:

(i) identify any instructional difficulties,

(ii) ensure comprehension of each part of the questionnaire, and

(iii) establish to what degree the group of subjects used in the study were a representive sample of competitive gymnasts.

The researcher administered these questionnaires to most of these subjects. However, due to geographical limitations, some questionnaires were mailed out and administered by the coach. The analysis of these data revealed that using either the sample of only college-aged gymnasts, or the total sample, the scores of the research subjects were within one standard deviation of the mean of the pilot subjects. Thus, generalizability of the results of the stress ratings of

gymnastics skills used in this study may be valid for a more diverse population of female gymnasts than just college-age female gymnasts.

The test/retest reliability of SARP has not been established. Accordingly, subjects may have been inconsistent in their definitions of each number on the stress scale between the pre-test and post-test. (i.e. A rating of "6" at pre-test time may have only been a "4" at post-test time.).

Post-Research Questionnaire

The post-research evaluation was completed by all subjects after the last testing session. The questions were open-ended so as not to prompt specific responses. The questionnaire completed by the modified-experimental subjects (Appendix F_1) was less extensive than that for the experimental subjects (Appendix F_2).

These data included comments on the methodological procedures used to collect the physiological and performance data. In addition, the subjects were encouraged to respond judgmentally regarding their perception of feelings toward, and like or dislike toward the treatment, as well as their participation as a research subject. These data were valuable in explaining some of the inconsistencies and idiosyncracies in the physiological and performance data.

Treatment of Data

The performance data was collapsed into three median scores, one score for each of the three sets of five trials of each skill progression. These median scores were then separated into thirds. For each third, a median score was determined. Thus, there were three medians for each phase of the study (baseline, treatment and post-treatment).

For purposes of performance data analysis, the treatment phase was further divided into two parts, *treatment*$_1$ and *treatment*$_2$ (Appendix A). The researcher felt that there would be a lag time between the onset of treatment and its application to the performance setting.

Consequently, the seventh testing day following the onset of treatment was chosen as the beginning of the second part of the treatment phase (*treatment*$_2$). This period of time allowed the subject to complete Tape 1 and be half way through the allotted testing time for Tape 2. Thus, the subject had sufficient instruction in the protocol of the modified relaxation treatment.

A robust slope was calculated for each phase using the first and last median score within the experimental phase (Tukey 1977). These slopes were used as measures of drift, with which the changes in rate of performance between baseline and treatment phases were determined. The range of all the median scores within each phase was used as a measure of variability. The range was used to determine the consistency of performance between baseline and treatment phases. The level of performance was calculated from the mean of the medians for each experimental phase.

One *high-stress* and one *low-stress* skill were determined for each subject using the highest and lowest stress rating totals of the skills (Part C: SARP). The comparison of the high- and low-stress skills was used during evaluation of the data analyses. Pre-test/post-test SARP scores and medians for all skill progressions were compared within each subject to determine any changes in stress ratings over the fifteen weeks of data collection. to determine any changes in stress ratings over the fifteen weeks of data collection. Median scores were also calculated using only the skill progressions that the subject had performed during the study.

H. Internal Validity

The extent to which an experiment demonstrates unambiguously that the intervention accounts for change can be measured by the degree of internal validity present. The internal validity of the single case time-series design can be threatened by history, maturation, testing, statistical regression, and instrumentation.

"Any event occurring at the time of the experiment that could influence the results or account for the pattern of data otherwise attributed to the intervention" (Kazdin 1982, p 78) is

considered a possible threat due to *history*. In this study, a delay of treatment intervention for one of the experimental groups (E 2) as well as the group (E 3) who received no treatment, served as guards against threat due to historical events. Subjects were tested on the same days and at the same times every week, reducing further chance of historical validity threats.

Any changes resulting from internal processes within the individual, are considered threats due to *maturation*. The duration of the study, fifteen weeks, was a short amount of time for any maturation effects to occur that would effect the physiological variables. The order of performance skills was rotated sequentially for each testing session starting with the opposite gymnastic event and a new skill each day. This was done to control for muscular fatigue factors that may have accounted for improved performance on some skills and reduced performance on others.

Any confounding due to repeated assessment of physiological or performance variables, threat due to *testing*, would have appeared during the baseline phase if it was to surface at all.

Statistical regression of scores toward the mean could have presented a possible threat to the internal validity in this study. For both physiological and performance variables, there were possible floor and ceiling effects, which would not allow any further expansion of the range of scores (Kazdin 1980). Any statistical analyses done on the results may not have shown significance due to the fact that any scores near the high or low end of the scale had little room to increase or decrease respectively. Clinically or practically, however, these changes may be of a significant nature.

The threat to internal validity by *instrumentation effects* is reflected in any "change in measuring instrument or assessment procedure of observers whose judgments about criteria for scoring behavior change over time" (Kazdin 1982, p 78). Attempts to control this possible threat were taken by checking batteries and calibrating the physiological instrumentation before testing each subject. On performance variables, videotaped recordings were made of all performance sessions for the purpose of scoring. Written and illustrated execution criteria for scores from zero to ten for each skill progression were available to the behavioral observers

during scoring sessions. Interobserver agreement was calculated to assess the degree to which both observers agreed upon scores for each trial.

I. External Validity

The generalization of results of a study to different subjects and situations is an important consideration for behavioral researchers. However, internal validity should not be sacrificed in order to gain external validity. "Generally, it is better to ensure that the experiment is internally valid, since it would be meaningless to generalize results of an internally invalid study" (Kratochwill 1978, p 11).

The treatment used in this study, Modified Progressive Muscle Relaxation, is one that has been used across varying subject populations (Jacobson 1938; Reinking & Kohl 1975). The modifications to the technique for this study were minor, and therefore were assumed to have little if any effectual change on the subjects' response to the treatment in general. Thus, the treatment has generalizability across subjects. Measurement of trapezius muscle tension, as opposed to another muscle group, may have limited generalization of results to only subject groups, within which this muscle group is relevant to the research question.

The subjects were aware they were participating in a study, which may have contributed as a threat to external validity. Response to the intervention may have been altered as a result of the awareness, known as the Hawthorne effect. Subjects in the modified-experimental group (E 3), who received no treatment, were not aware that there was any difference in their physiological monitoring sessions as compared to those of the experimental groups.

Repeated measurement of the dependent variables over the fifteen weeks increased the ecological validity of the results (Kratochwill 1978). By employing multiple dependent variables, the range of generalization to other physiological variables was increased. Self-report data served to explain in more detail the personality and situational factors that influenced a specific response pattern. This improved the generalization of the results.

J. Delimitations

Subjects used in this study were eight female gymnasts on The University of Alberta competitive gymnastics team during the 1982/83 season. Due to the small sample size and homogeneous group of subjects, generalizability of the results of this study to other populations was somewhat limited. The data collection was limited to a four month period from September through December prior to the onset of the competitive season. The treatment given to the subjects was limited to one type, a modified form of progressive muscle relaxation. This treatment was selected based on its practical application toward enhancing performance in fine motor movements necessary in gymnastics skill.

The three physiological variables, Electromyogram, Electrodermal Activity, and Peripheral Temperature, were selected due to their established relationship with gymnastics. Many gymnastics skills use the shoulder girdle either in inverted or hanging positions. Muscle tension of the trapezius (EMG) was measured to examine whether or not the treatment (Progressive Muscle Relaxation) had any physiological effect on such an important muscle group. A common physiological response noted in gymnasts is increased sweat gland activity under performance conditions. Electrodermal Activity (EDA) was measured during treatment sessions to observe any change in sweat gland activity. Since individuals may respond in different modes, peripheral temperature (TEMP) was chosen as the third physiological variable to be monitored. The physiological measurements were limited to two thirty-minute sessions twice a week.

Five gymnastics skills on balance beam and five on uneven parallel bars were selected to measure skill performance. The criterion used for skill selection was that the whole skill could be executed on the floor prior to using the apparatus. Progressive stages within each of the ten skills were designed as efficient measures of performance improvement. All performance sessions were videotaped in the gymnasium. The subjects had been previously exposed regularly to videotaping. Any performance sessions missed by subjects due to injuries or time constraints were considered missing data unless made up under the same experimental

conditions within two days of the absence.

A scoring method for each gymnastic skill was designed according to international gymnastics judging rules and relative to the progressive hierarchy of performance for each skill. The scoring method was made as objective as possible to reduce the amount of variation in scores between the judges. The videotapes were sequentially stored and later judged by a rated gymnastics judge, who was unfamiliar with the subjects. A representative sample of the taped sessions, presented in random order, was chosen for evaluation by the outside judge to determine interobserver reliability.

Practice sessions were limited to two per week, in which each subject performed fifteen repetitions of each of the ten skills. A specific achievement criterion performance rating, 8 out of the 10 points possible, was verified by gymnastic judging experts and was set as the point at which the gymnast was permitted to move on to the next skill progression.

K. Limitations

One treatment, Modified Progressive Relaxation, was administered to all experimental subjects. With reference to the Law of Response Specificity, there is a unique pattern of physiological responses for each individual. A different treatment may have invoked a different response pattern. The particular treatment chosen for this study may not have been the most effective one for inducing an unstressing response in each specific subject. The treatment that was compatible with each individual's most reactive response system may have implied different and perhaps more dramatic results in the physiological data.

Measurement of muscle tension was only monitored on the left trapezius muscle. For all experimental subjects, this may not have been the optimal site for obtaining differences in muscle tension. Some of the variation in the physiological data may have been caused by external body movements.

The duration of the treatment program was eight weeks for all subjects. Each ten-minute tape was listened to every day for two weeks. Some of the individuals may have

needed a longer daily or weekly time period to learn the treatment technique. Others may have learned it at a faster rate. Implementing the same treatment for the same duration to each subject disregards individual differences in responsivity and learning rates and may have influenced the results of this study.

One consideration of time-series design is the motivation of the subjects to participate in the repetitious data collection procedures. Although the subjects in this study were present at every testing session, unless injured, the experimenter had no control over the effort put forth in each session. External events in their daily lives may have also influenced their attitude during the experimental sessions.

With respect to the self-report measurement instruments, various assumptions were considered. Each subject completed the instruments with her own degree of honesty and concern. There was a certain amount of individual interpretation inevitable in this type of measurement instrument. The self-report measures were designed specifically for gymnasts and pertained to the particular gymnastic skills used as performance criteria in this study.

Due to the fact that there were no physiological measurements taken during the actual skill performances in the gym, there can only be assumptions made about the direct effect of the treatment on the subject's performance of gymnastic skills.

The researcher in this study also was the gymnastic coach of the subjects. In the role of researcher, the physiological and performance data were collected, in addition to recording observational data from each testing session. Simultaneously, in the role of coach, daily practices were conducted for the subjects as members of the competitive gymnastics team. Playing the dual roles of researcher and coach may have had both negative and positive effects on the results of this study.

For some athletes, the coaching role connotates an authority figure, to whom the athletes look up and perform in order to please the coach. The coach shows support for the unstressing program which promotes the athlete's acceptance of it. Within the physiological and psychological data collection, this factor may have been influential. This may have been a

concealed motive for some of the subjects to perform as well as they could. On the other hand, playing dual roles enabled the researcher to develop a closer relationship to the subjects and use a humanistic orientation during the study. This increased the degree of communication between researcher and subject, which accounted for more in-depth observational data to be recorded.

L. Assumptions

The following assumptions have been made by the researcher.

1. Each of the experimental subjects had a need to learn how to decrease arousal level. Increasing arousal level was not considered in this study.

2. According to Jacobson (1938), Progressive Muscle Relaxation enhances the individual's awareness of muscle tension. Therefore, it was assumed that the subjects would be most responsive physiologically on electromyogram (EMG) due to the nature of the treatment.

3. It was assumed that all subjects wanted to develop an efficiency in using the unstressing treatment.

4. Since there was no direct link between the treatment and the performance testing, it was assumed that there would be a lag time between learning the technique and applying it in the performance setting. This was particularly true in this study since there was no attempt by the researcher to encourage the subjects to apply the unstressing technique to the performance situation.

M. Research Questions

From the literature, it can be argued that there is evidence both of physiological and overt behavioral effects of stress. One of the techniques used to control the intensity of stress is unstressing. It was the purpose of this study to attempt to determine the physiological and psychological effects of unstressing on the individual as well as how the technique indirectly affected performance.

The first purpose was to evaluate the direct effect of the unstressing training on three physiological variables (EMG, EDA and TEMP). Physiological monitoring instrumentation, taped unstressing instructions and self-report measures were used to achieve this purpose.

A number of research questions were examined. Based on the literature review, the data were expected to demonstrate specific tendencies and directions.

1A. Will female gymnasts, given an eight week training program in Modified Progressive Relaxation, demonstrate decreased muscle tension (EMG) and electrodermal activity (EDA), and increased peripheral temperature (TEMP) during treatment sessions and over the duration of the study?

2A. Will the comparison of the pre-training and post-training physiological measurements of experimental subjects within each treatment session reveal a decrease in EMG and EDA measurements, and an increase in TEMP measurements?

3A. Will there be a correlative interrelationship among the three physiological variables, which shows a positive correlation between EMG and EDA, and a negative correlation between TEMP and EMG, as well as TEMP and EDA?

4A. Will there be a correlative trend between self-reported level of unstressing during treatment (measured by RUS) and the actual physiological data during training sessions?

The second purpose of the study was to explore the extent to which the unstressing training affected the subject's cognitive appraisal of the skills and her performance on the gymnastic skills. The use of videotaped skill performances as well as self-reports of stress levels aided in this evaluation.

These additional questions were examined:

1B. As a result of unstressing training, will there be a change in self-report stress ratings of skill progressions when comparing pre to post measurements as measured by SARP?

2B. Will there be a trend of baseline performance to treatment performance data that will show an increase in level and/or slope as well as a decrease in variability during the treatment period?

IV. RESULTS OF PHYSIOLOGICAL DATA ANALYSIS

It was the purpose of this study to examine the effects of modified progressive relaxation training on physiological and performance parameters of the eight subjects. Due to the large amount of data, the physiological data were reported and summarized for each subject, followed by the discussion and summary of the performance data. In the final section of this chapter, the analyses of the physiological and performance data were brought together in an attempt to globally integrate the findings within each subject.

A. Introduction

The results of the physiological analysis were divided into two parts. Statistical analysis was done to determine whether or not there were any changes in mean level or direction and rate of change between baseline and treatment phases. Part 1 consists of the results of the time-series analysis for all subjects within each modality.

The second part of the physiological data analysis section uses the observational data and self-report data (RUS and the post-research questionnaire) to visually analyze and interpret the data for each individual. A clinical approach to the analysis in this section allows for possible explanation of idiosyncracies that appear in each individual's data. These interpretations are based on the statistical analyses as well as the subjective data that was collected.

In this study, the research questions with regard to the physiological variables, were directed toward the physiological effects and the subject's thoughts and feelings toward the unstressing treatment on the individual. The results and discussion reflect upon the analysis primarily from a single case perspective. Post-treatment data were used as supplemental information for conclusions drawn in answer to the direct effects of the treatment. With reference to the research questions, four analyses were discussed for each subject. The section on Statistical Analysis refers to the first analysis. All four analyses are discussed within the Subjective Data Analysis section, and are denoted by the number that corresponds to the

analysis.

1. **Trends in Baseline, Pre-Training and Post-Treatment Data**[6].

This analysis revealed any effect of the treatment on the subject, that occurred over a period of time. If the subject was able to apply the unstressing treatment to herself outside of the laboratory, the pre-training and post-treatment data should have shown lower values. This implied a lag time, from the beginning of the pre-training phase to the time when the subject became familiar and comfortable enough with the treatment to effectively apply it without the taped instructions. This lag time was most likely different for each subject, and thus can only be estimated from the available data. An underlying assumption here was that the subjects wanted to become effective users of the unstressing technique.

2. **Pre-Training/Post-Training Differences within Sessions.**

The direct effect of the taped unstressing instructions during the laboratory treatment sessions on the subject were discussed in this analysis.

3. **Interrelationship among the Physiological Variables.**

These analyses explored whether or not the treatment had the same effect on each of the three physiological variables. This yielded information as to which physiological response system of each individual reacted to the particular type of unstressing training used in this study.

4. **Relationship of Physiological Data to Self-Report Data.**

If the subject was attuned particularly to one physiological system, an examination of the relationship of self-report data to all three physiological variables identified the most active system. It also allowed the researcher to determine whether the subject was aware of the physiological system that was most reactive to the treatment in the direction associated with the relaxation response.

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[6]The *baseline, pre-training*, and *post-treatment* physiological data describe the initial measurements taken within each session during the baseline, treatment, and post-treatment phases of the study.

The individual discussions of these questions were then integrated into a summary of the physiological findings for each subject. The results were discussed particularly in reference to the *stress/relaxation response* as discussed in the literature. This "response" advocates the following physiological responses occurring in response to relaxation: a decrease in electrodermal activity and muscle tension, and an increase in peripheral temperature. The opposite of these are predicted to occur in response to a stressful situation.

Although Subjects 6, 7, and 8 did not receive the treatment, results of their data were analyzed and reported. Physiological measurements using baseline procedures were taken on each of these subjects throughout the fifteen week study. The data were separated into three parts corresponding to the baseline, pre-training and post-treatment phases of the experimental subjects. These data were evaluated with regard to their level, trend, and variability, as well as any interrelationships that were evident among the physiological variables. These data were further used in comparison with trends found in the data of Subjects 1 through 5 who did receive treatment.

B. Statistical Analysis

Upon examination of the physiological data, an important consideration must be accounted for when interpreting the data analysis. Muscle tension, electrodermal activity and peripheral temperature have biological limits, particularly a lower limit. Within these limits, the Law of Initial Values (Wilder 1957) has an influential effect upon the interpretation of the data.

> Not only the intensity but also the direction of a response of a body function to any agent depend to a large degree on the initial level of that function at the start of the experiment. The higher this "initial level", ...the greater is the response to function-depressing agents. This rule holds true for 75-85% of all experiments. (Wilder 1957, p 73)

Accordingly, when comparing baseline and pre-training data, a small or insignificant decrease may be due to the low initial value which prevents a large decrease from occurring over time. As this law affects 75-85% of all studies, it may be a justifiable explanation for some of the

results found in these data.

Self-report data in several forms were used as a supplement in an attempt to interpret possible reasons for data trends and disagreements with the expected directions. The Rating of Unstressing Sessions (RUS) related the individual's interpretation of her level of stress prior to and after each treatment session. Comments accompanying the RUS were also used as supplemental information. A post-research questionnaire completed by each subject presented personal perceptions of the treatment sessions. In particular, comments regarding some or all of the four treatment tapes were used as an aid to data interpretation.

Electromyogram

Table 2 illustrates descriptive statistics of the baseline, pre-training, and post-treatment data. For Subject 1, the overall mean decreased from the baseline to the post-treatment phase, showing a decrease in trapezius muscle tension across time. The variability of the mean scores also decreased across time. Thus, the level of trapezius muscle tension decreased throughout the treatment and post-treatment phases with fewer high peaks in the measurements. While the visual analysis of this data shows some possible effects of the treatment, statistical analysis showed no significance. The time-series analysis outlined in Table 3 showed no significant level or slope change of EMG data for Subject 1.

The EMG measurements for Subject 2 showed a consistency within sessions and across all phases of the study. Table 2 shows a decrease in the EMG means from baseline to post-treatment, all of which were very low measurements throughout the study. The variability within all phases was also low. This small degree of variability along with the initial level of the measurements explains the finding of no significant change in slope. Graphical display of the data shows that the baseline measurements were slightly higher than the pre-training measurements. Statistically, this level change between baseline and pre-training was found to be significant at the .01 alpha level (Table 3).

Table 2
Descriptive Statistics of
Baseline, Pre-Training, and Post-Treatment Physiological Data[7]

Subj.	Baseline Mean	Baseline (St. Dev.)	Pre-Training Mean	Pre-Training (St. Dev.)	Post-Treatment Mean	Post-Treatment (St. Dev.)	Pre-Training Means Below Baseline Mean	Pre-Training Means Above Baseline Mean
				EMG (Mvolts)				
1	2.25	(1.52)	1.37	(0.30)	1.11	(0.22)	14	2
	*1.66	*(0.56)						
2	0.76	(0.08)	0.64	(0.09)	0.62	(0.11)	15	1
3	1.62	(0.28)	1.46	(0.18)	1.30	(0.40)	11	5
4	1.84	(0.51)	1.52	(0.32)	---	----	13	2
5	1.81	(0.97)	1.25	(0.28)	---	----	14	1
	*1.59	*(0.65)						
6	1.99	(0.72)	2.26	(1.09)	2.06	(0.94)	5	11
7	1.52	(1.03)	2.17	(1.71)	2.66	(2.56)	5	11
			*1.63	*(0.94)	*1.73	*(0.78)		
8	1.73	(0.49)	1.46	(0.32)	1.30	(0.34)	11	5
				EDA (mhos)				
1	6.20	(2.72)	9.72	(7.07)	8.20	(3.61)	3	13
			*8.10	*(3.35)				
2	5.21	(2.38)	6.20	(2.23)	7.07	(2.82)	5	10
3	9.22	(2.12)	10.05	(3.20)	14.01	(3.41)	5	10
4	5.44	(2.47)	6.58	(3.28)	---	----	8	7
5	4.64	(3.13)	8.90	(1.98)	---	----	0	15
6	18.57	(5.64)	27.10	(11.87)	16.52	(4.15)	4	12
			*24.68	*(7.13)				
7	7.15	(2.78)	8.02	(3.97)	7.46	(1.33)	8	8
			*6.75	*(2.13)				
8	7.79	(2.68)	12.56	(3.42)	13.06	(2.93)	0	16
			*12.04	*(2.83)				

* Data points which were at least 2 standard deviations above the mean were omitted from these calculations.

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[7] For Subjects 4 and 5, there were too few data points during the post-treatment phase to obtain a representative mean.

Table 2 (cont)

Subj.	Baseline Mean	Baseline (St. Dev.)	Pre-Training Mean	Pre-Training (St. Dev.)	Post-Treatment Mean	Post-Treatment (St. Dev.)	Pre-Training Means Below Baseline Mean	Pre-Training Means Above Baseline Mean
				TEMP (F degrees)				
1	92.38	(5.33)	95.07	(0.93)	95.33	(0.98)	4	12
	*94.55	*(0.40)						
2	89.55	(7.14)	85.39	(8.28)	89.03	(6.82)	9	7
3	94.09	(1.17)	93.24	(1.96)	93.39	(1.06)	11	5
4	77.15	(7.68)	72.04	(2.75)	---	----	12	3
	*74.24	*(3.84)						
5	92.70	(1.84)	93.17	(1.53)	---	----	6	9
	*93.09	*(1.32)	*93.43	*(1.16)				
6	93.37	(2.54)	91.26	(4.88)	91.37	(3.81)	10	6
7	85.31	(10.29)	84.71	(10.38)	84.00	(9.87)	7	9
8	76.79	(1.82)	77.14	(5.33)	80.75	(8.24)	10	6
			*76.04	*(3.08)				

* Data points which were at least 2 standard deviations above the mean were omitted from these calculations.

Table 3
Time Series Analysis
EMG Measurements during Baseline and Treatment Phases

Subj	Baseline Start Level	Baseline Slope	Baseline End Level	Treatment Start Level	Treatment Slope	Treatment End Level	Level Change	"t"	Slope Change	"t"
1	2.31	-.05	0.81	1.43	-.01	0.63	0.62	1.00	0.04	0.38
2	0.88	.00	0.88	0.58	-.01	-0.22	-0.30	**-3.35**[1]	-0.01	-1.08
3	1.30	.02	1.90	1.46	.00	1.46	-0.44	**-4.43**[1]	-0.02	**-4.30**[1]
4	2.68	-.02	1.48	2.28	-.01	1.48	0.80	**2.55**[1]	0.01	0.40
5	3.85	-.04	1.45	1.46	.00	1.46	0.01	0.03	0.04	1.26
6	1.17	.05	2.67	2.19	.00	2.19	-0.48	-1.00	-0.05	**-2.12**[2]
7	3.64	-.14	-0.56	3.70	-.03	1.30	4.26	**6.23**[1]	0.11	**2.82**[1]
8	1.20	.03	2.10	1.43	.00	1.43	-0.67	**-3.22**[1]	-0.03	**-2.75**[1]

[1] $p < .01$
[2] $p < .025$
[3] $p < .05$

The EMG data for Subject 3 showed a significant level change and slope change between the baseline and treatment phases (Table 3). The low variability of the scores within each phase, emphasizes the consistency of the EMG means.

The statistical analysis revealed a significant increase in level between the end of the baseline phase and the beginning of the pre-training phase of the EMG data for Subject 4 (Table 3). This is in conflict with the expected decrease in EMG over time, as reflected in a lower pre-training mean than baseline mean (Table 2). This increase in level when treatment started may have reflected an adjustment to the treatment. This was further supported by observing negative slopes during both phases, even though they were small and the change between phases was insignificant.

There was not substantial evidence in the data of any of the physiological variables of a treatment effect on Subject 5 (Table 2). There was a decrease in EMG means from baseline to pre-training. Statistically, this level change was not significant, as shown in Table 3.

The EMG data for Subject 6[8] showed variability throughout the thirty days (Figure 16). Table 2 shows that there was an increase in mean level from baseline to pre-training with a return to baseline level during the post-treatment phase. The statistical analysis revealed this level change to be non-significant. Table 3 does show a change in slope between baseline (.05) and pre-training (.00), significant at the .025 alpha level. This showed a leveling off of the pre-training EMG measurements. The variability throughout the data may have influenced the analysis by reducing the consistency of any trend in the data.

The EMG data for Subject 7 also showed variability but of a cyclic nature. The peaks were interspersed with rather stable data. The mean EMG level increased from baseline through post-treatment phases (Figure 19). The results of the statistical analysis (Table 3) revealed a significant increase in level between baseline and pre-training, a finding in opposition to the response associated with "relaxation". The baseline slope, (slope=-.14), remained

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[8] The reader is reminded that Subjects 6, 7, and 8 did not receive treatment. The data, however, for these subjects were separated into the three phases (baseline, pre-training, and post-treatment) for comparison of these results to those of Subjects 1-5 who did receive treatment.

negative during pre-training but at a lesser rate of decline (slope= -.03). This was shown to be a significant change in slope (Table 3). The literature reveals that these findings coincide with the stress response. These "control" subject responses, a decrease in intensity of the slope during pre-training and a significant increase in level between the two phases, lend indirect support to the possibility of a treatment effect on the experimental subjects.

The EMG data for Subject 8 showed positive effects during the pre-training phase even though she received no treatment. Table 3 shows a significant level decrease of the EMG data between baseline and pre-training ($t = -3.22$; $p < .01$). The slope of the data also changed significantly from a slight positive trend (+0.03) in baseline to a flat level during the pre-training phase. The EMG means and variability decreased consistently across all phases (Table 2). These data are indicators of the relaxation response manifested in decreased muscle tension.

Summary

The results illustrated in Table 2 indicate that all of the subjects except Modified-Experimental Subjects 6 and 7 showed a decrease in the mean level and variability of muscle tension when comparing baseline to treatment phases of the study. However, the time-series analysis revealed that only Subjects 2, 3, and 8 showed significant decreases in muscle tension level. On the other hand, Subjects 4 and 7 showed significant increases in level, a response that opposes that of the physiological effects of relaxation.

When examining the rate of change between baseline and treatment phases, Subjects 3, 6, and 8 showed change from a positive slope during baseline to no slope during the treatment phase.

If the treatment, Modified Progressive Relaxation, was an effective trapezius muscle tension reducer, these results of the experimental subjects should have shown a decreased level of EMG measurements and/or a decrease in slope during the treatment phase[9]. Subjects 3 and 8 were the only subjects who showed both a decrease in level and slope of their EMG

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[9] The statistical changes that would occur are dependent upon the initial value during baseline.

measurements. Therefore, from the statistical analyses, Modified Progressive Relaxation was not shown to be an effective reducer of trapezius muscle tension for these subjects in this particular study.

Electrodermal Activity

Electrodermal activity did not respond to the treatment by showing an expected decrease in pre-training measurements over time. For all eight subjects, the EDA means increased from baseline to treatment phase (Table 2). Statistically, the EDA data revealed no significant changes (Table 4). The variability of means decreased during the treatment phase only for Subjects 2 and 5. An increased mean EDA level and decreased variability during the treatment phase indicates that electrodermal activity increased and remained consistent at this higher level, indicative of the stress response.

Peripheral Temperature

The mean TEMP measurements for Subject 1 showed that there was a slight increase in level of the pre-training and post-treatment measurements over the baseline TEMP means. There were no significant level or drift changes found between the TEMP baseline and pre-training measurements (Table 5). The TEMP measurements continued to rise slightly during the post-treatment period. The biological limit of this variable may have effected the degree to which the TEMP measurements could have increased.

The TEMP measurements for Subject 2 showed great variability in all phases, the greatest being within the pre-training measurements (Table 2). The mean of the pre-training phase dropped four degrees from that of the baseline and then returned to near baseline level during the post-treatment phase. The cyclic tendencies of the data were accounted for in the time-series analysis, yet determined no significant level or drift changes between the baseline and treatment data (Table 5).

Table 4
Time Series Analysis
EDA Measurements during Baseline and Treatment Phases

	Baseline...............			Treatment						
Subj	Start Level	Slope	End Level	Start Level	Slope	End Level	Level Change	"t"	Slope Change	"t"
1	7.34	-.06	5.54	5.23	.13	15.63	-0.31	-0.12	0.19	1.38
2	0.92	.38	12.32	9.22	.09	15.97	-3.10	-1.38	-0.29	-0.20
3	12.89	-.13	8.99	7.64	.10	15.14	-1.35	-0.66	0.23	0.49
4	6.16	.04	8.56	8.08	-.07	2.48	-0.48	-0.23	-0.11	-0.30
5	2.19	.08	6.99	6.22	.01	7.02	-0.77	-0.49	-0.07	-0.33
6	16.73	-.08	14.33	29.61	-.21	12.81	15.28	1.83	-0.13	-0.07
7	11.42	-.24	4.22	4.24	.04	7.44	0.02	0.01	0.28	0.53
8	3.22	.29	11.92	8.04	.14	19.24	-3.88	-1.74	-0.15	-0.33

Table 5
Time Series Analysis
TEMP Measurements during Baseline and Treatment Phases

	Baseline...............			Treatment						
Subj	Start Level	Slope	End Level	Start Level	Slope	End Level	Level Change	"t"	Slope Change	"t"
1	91.50	.06	93.30	94.37	.01	95.17	1.07	0.83	-0.05	-0.71
2*	----	--	----	----	-	----	--	-0.13	--	-0.83
3	94.37	-.02	93.77	94.07	-.02	92.47	0.30	0.37	0.00	-0.07
4	78.56	-.06	74.96	71.87	.25	91.87	-3.09	-0.91	0.31	0.53
5	92.26	-.07	88.06	92.85	.02	94.45	4.79	**3.38**[1]	0.09	0.41
6*	----	--	----	----	-	----	--	-0.58	--	-0.38
7*	----	--	----	----	-	----	--	**2.09**[2]	--	-0.21
8	78.05	-.10	75.05	83.44	-.11	74.64	8.39	**2.62**[1]	-0.01	-0.02

* The data series for these subjects was of a cyclic or seasonal nature. Therefore, the values for starting and ending levels and drift could not be calculated.

[1] $p < .01$
[2] $p < .025$
[3] $p < .05$

The TEMP means reflected no significant decrease in level between baseline and pre-training phases for Subject 3 (Table 5). There was little variability within phases, possibly explained by the rather high initial temperature level.

The TEMP data for Subject 4 also showed little supportive evidence for the treatment effecting the subject by increasing her peripheral temperature (Figure 12). The overall mean level of the pre-training phase (72.04 degrees) was below that of the baseline phase (Table 2).

Table 2 shows a very slight increase (0.34 degrees) in TEMP means from baseline to pre-training for Subject 5. The time-series analysis, which used the five one-minute data points for each session, found the level of TEMP scores from the end of baseline to the beginning of pre-training to significantly increase (Table 5).

The TEMP data for Subject 6 showed increased variability in the pre-training phase (Table 2). The decreased mean level (91.26 degrees) during pre-training was not a statistically significant change (Table 5).

Subject 7 had the largest degree of variability in TEMP scores of any of the subjects (Table 2). The cyclic data did reveal an increase in level, significant at the .025 alpha level (Table 5). The variability remained at a rather constant high level throughout all phases.

Although the level change of TEMP data for Subject 8 significantly increased at the beginning of the pre-training phase (Table 5), the slopes of each phase were negative, indicating a decrease in peripheral temperature during both phases. The rate of decrease between phases (slope) did not significantly change between phases. This decrease in temperature is, according to the literature, associated with an increased stress level.

Summary

Only three subjects showed an increase in peripheral temperature during the treatment phase that would be an expected relaxation response. However, two of these (Subjects 7 and 8) were modified-experimental subjects. In conclusion, these results indicate that the Modified Progressive Relaxation treatment had no effect on reducing peripheral temperature on the experimental subjects in this study.

For all three modalities, the statistical analyses indicate no statistical evidence that the treatment effected the physiological responses of the subjects in a manner consistent with the expected responses that accompany relaxation.

C. Subjective Data Analysis

Self-report data in several forms were used as a supplement in an attempt to interpret possible reasons for data trends and disagreements with the expected directions. The Rating of Unstressing Sessions (RUS) related the individual's interpretation of her level of stress prior to and after each treatment session. Comments accompanying the RUS were also used as supplemental information. A post-research questionnaire completed by each subject presented personal perceptions of the treatment sessions. In particular, comments regarding some or all of the four treatment tapes were used as an aid to data interpretation.

Subject 1

(1) While the EMG data showed no significant level or slope changes during treatment, a possible consideration to account for these results is a "floor effect", which allowed little room for the measurements to decrease. The high EMG mean on Day 4 influenced the baseline mean and its relatively large standard deviation (Figure 1). She was late leaving home on that day and after riding her bicycle into school in a hurry, arrived late to the testing session. Subject 1 may have responded to this situation with increased muscle tension. Without the ability to alter her interpretation of the situation as stressful, and without skills to effectively reduce the muscle tension, her tension level remained high for the fifteen minutes of the baseline treatment session. A stabilization period prior to taking the actual physiological measurements was mandatory in each testing session. Her EMG level had to maintain a stable level for one minute prior to the beginning of the collection of data for baseline measurements. The five one-minute measurements on Day 4 showed an erratic pattern ranging from 3.9 to 6.4 Mvolts. From these data, it seems unlikely that this was due to lack of adjustment to the

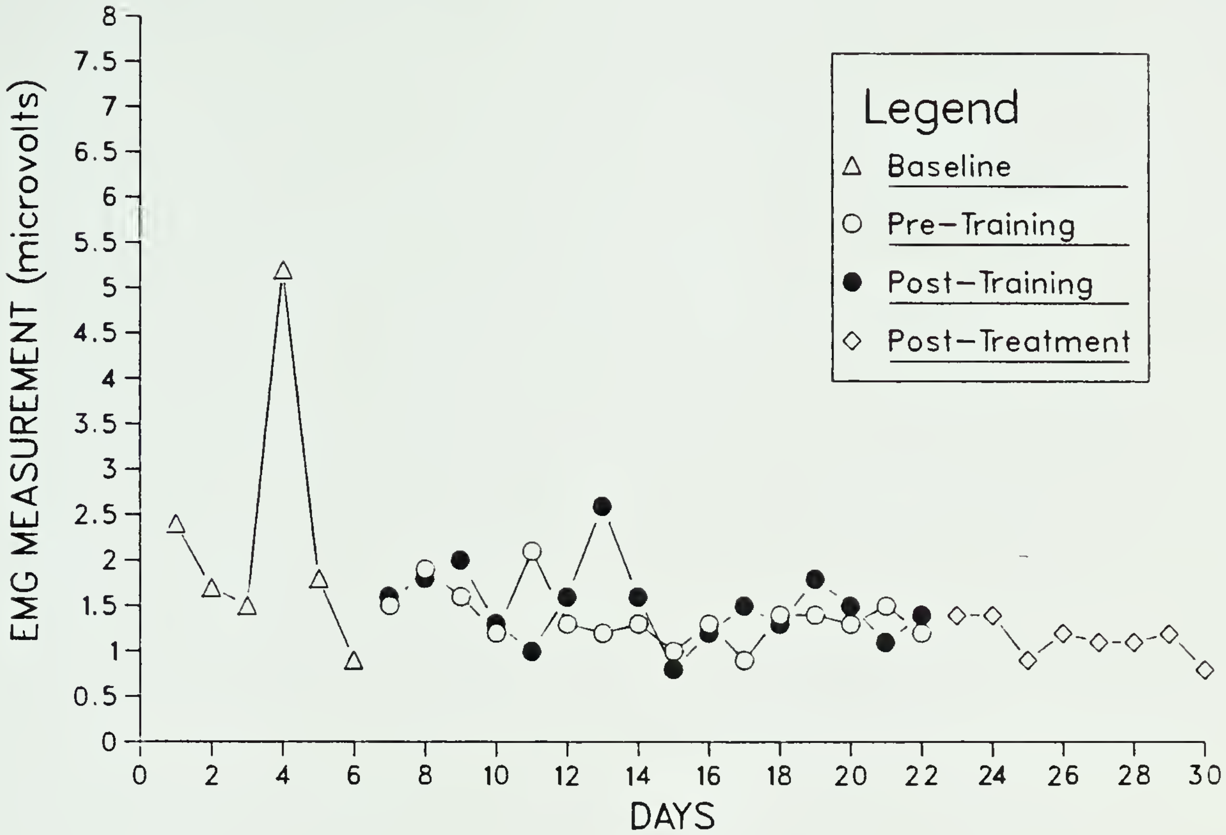

Figure 1. Daily EMG Means: Subject 1

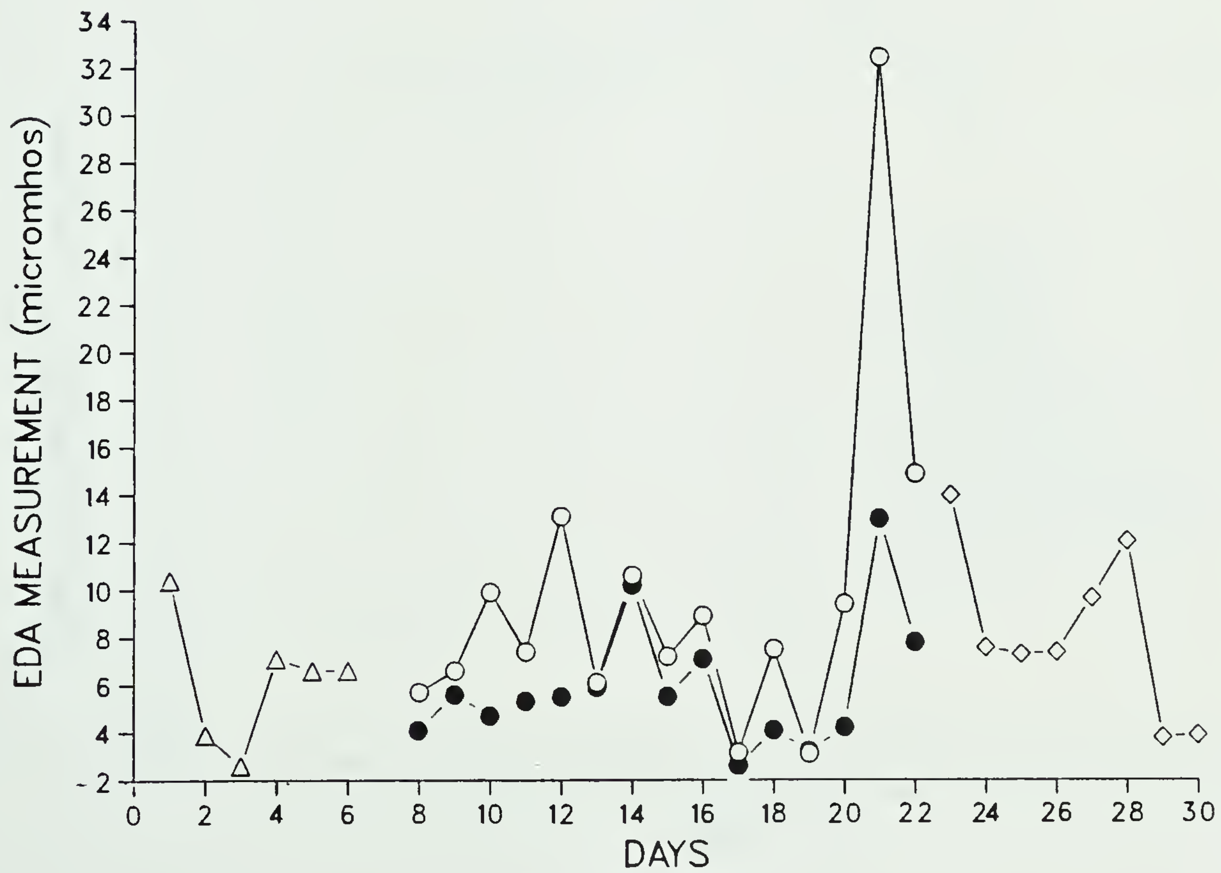

Figure 2. Daily EDA Means: Subject 1

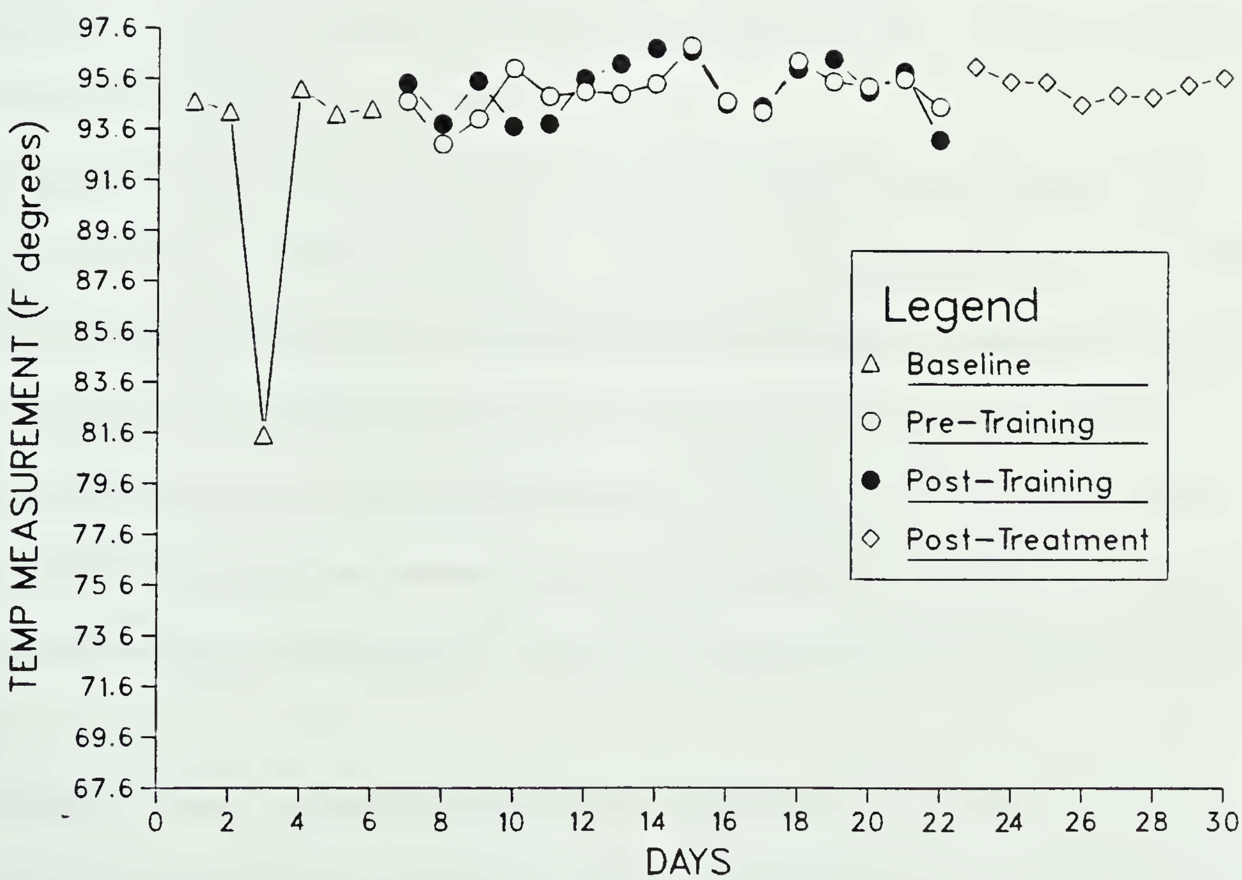

Figure 3. Daily TEMP Means: Subject 1

instrumentation. More likely, it shows that the subject was not able to reduce and stabilize her muscle tension within the fifteen minute period of the baseline session. Supportive evidence of this explanation is also shown by the high EMG pre-training data on Day 11 (Figure 1). The decrease in post-training data on this day suggests that the treatment may have helped the athlete reduce muscle tension when the initial level of muscle tension was high.

The EMG means for Days 8 and 11 were the only two pre-training means higher than the baseline mean (Table 2). In the post-research questionnaire, Subject 1 stated that "By about the third week or so, I think the relaxation exercise and the concentration of self-control transformed into more of an attitude about my life and my environment instead of just a daily routine or a series of exercises". It can be seen from Figure 1 and some further calculations that with the exception of the first five testing days (Days 7-11), the pre-training EMG scores seemed to stabilize at a level of 1.2 Mvolts with only a 0.17 standard deviation. The post-treatment scores decreased slightly more to a 1.1 mvolt level (0.22 standard deviation) (Table 2). These data support the subject's observation that it took three weeks, (from Day 7 to 12), for her to understand the concepts of the relaxation procedure and to be able to apply them toward the reduction of muscle tension.

Electrodermal activity in Subject 1 did not respond to the treatment by showing an expected decrease in pre-training measurements over time. In fact, the descriptive data (Table 2) show that thirteen of the fifteen pre-training EDA measurements were above the level of the overall baseline mean. The EDA measurements for Subject 1 in all three phases showed moderate variability except for one extremely high point (Figure 2). The five one-minute averages for Day 21 did not show excessive variation, revealing that the level of electrodermal activity was rather stable at this high level. There is no apparent reason that explains this data pattern.

Subject 1 showed no significant effect from the treatment on peripheral temperature. Excluding the one extremely low mean (Day 3) during the baseline phase, the resultant mean of 94.55 was below that of twelve of the sixteen pre-training means (Table 2). Data for Days 8,

9, 17, and 22 revealed means that were below the baseline mean level. The means for Days 17 and 22 were only very slightly below the baseline mean (-0.21 and -0.07 degrees, respectively). Days 8 and 9 were at the beginning of treatment, when the subject may not have been familiar enough with the treatment.

(2) Within testing sessions, it was expected that the pre-training/post-training differences would be negative, indicating a positive effect of the treatment. For Subject 1 (Table 6), more of pre-training/post-training EMG means increased than decreased. Although the overall means for pre-training and post-training measurements showed an increase from 1.31 to 1.51 Mvolts, the graphed data in Figure 1 show that Day 13 may have had a substantial influence on the post-training overall mean. No explanation from the available data sources can be given for the high post-training value on Day 13. There was no apparent pattern of the sequence of difference scores for each session (Table 7).

The data on electrodermal activity does however support the expected decrease during the treatment phase. Fourteen of the fifteen days showed a decrease in the post-training mean (Table 6). The overall means supported this finding by exhibiting a decrease of nearly four micromhos. Day 21, as seen in Figure 2, showed an unsubstantiated high pre-training EDA measurement. The observational data did not reveal any reason for this finding. Measurement error caused by instrumentation may have been responsible for the high data point on Day 21. Further support for this was found in the large decrease in electrodermal activity (-19.45 mhos) during the ten minute period of treatment administration on that day. Data could not be compared between subjects to determine the consistency of the instrumentation because none of the other subjects were measured on the same day. Omitting this data point from calculations, it can be seen in Table 6 that the variability in the pre-training measurements (3.35 mhos) was still at a moderate level, greater than that of the post-training measurements. Data for Day 19 showed the only increase of EDA during post-training. This increase was very small (+0.16 mhos) and as a result of the very low pre-training mean (3.05 mhos), a "floor effect" may have influenced these results. That level was the lowest one recorded at any time

Table 6
Descriptive Statistics of Pre-Training/Post-Training Physiological Data[10]

Subj.	No. Pre-trg Post-trg Incr	No. Pre-trg Post-trg Decr	Pre-Training Mean	Pre-Training (St. Dev.)	Post-Training Mean	Post-Training (St. Dev.)
			EMG	(Mvolts)		
1	10	6	1.37	(0.30)	1.51	(0.43)
					*1.42	*(0.33)
2	11	5	0.64	(0.09)	0.72	(0.13)
3	0	16	1.46	(0.18)	1.07	(0.32)
4	2	13	1.52	(0.32)	1.13	(0.21)
5	11	4	1.25	(0.28)	1.77	(1.27)
					*1.45	*(0.24)
6	--	--	2.26	(1.09)	--	--
7	--	--	2.17	(1.71)	--	--
			*1.63	*(0.94)		
8	--	--	1.46	(0.32)	--	--
			EDA	(mhos)		
1	1	14	9.72	(7.07)	5.92	(2.72)
			*8.10	*(3.35)		
2	4	11	6.20	(2.23)	5.60	(2.83)
3	6	9	10.05	(3.20)	9.52	(3.78)
4	4	11	6.58	(3.28)	5.28	(3.55)
5	13	2	8.90	(1.98)	11.37	(2.21)
6	--	--	*24.68	*(7.13)	--	--
7	--	--	8.02	(3.97)	--	--
			*6.75	*(2.13)		
8	--	--	12.56	(3.42)	--	--
			*12.04	*(2.83)		
			TEMP	(F degrees)		
1	9	7	95.07	(0.93)	95.21	(1.15)
2	6	10	85.39	(8.28)	85.62	(7.79)
3	11	5	93.24	(1.96)	93.37	(2.08)
4	15	0	72.04	(2.75)	76.14	(4.62)
5	9	6	93.17	(1.53)	93.19	(1.85)
			*93.43	*(1.16)		
6	--	--	91.26	(4.88)	--	--
7	--	--	84.71	(10.38)	--	--
8	--	--	76.79	(5.33)	--	--

* One aberrant point which was above 2 standard deviations above the mean was omitted from these calculations.

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[10] Subjects 6, 7, and 8 did not receive the treatment, therefore the post-training data is not available for these subjects.

Table 7
Difference between Pre-training and Post-training Physiological Means:
Subject 1

		EMG			EDA			TEMP		
	Day	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff
Tape 1	7	1.48	1.58	+0.10	----	----	----	94.69	95.37	+0.68
	8	1.86	1.79	-0.07	5.70	4.09	-1.61	93.01	93.84	+0.83
	9	1.57	2.00	+0.43	6.58	5.62	-0.96	93.97	95.51	+1.54
	10	1.22	1.32	+0.10	9.92	4.72	-5.20	96.01	93.67	-2.34
Tape 2	11	2.09	0.96	-1.13	7.43	5.32	-2.11	94.89	93.82	-1.07
	12	1.32	1.56	+0.24	13.10	5.54	-7.56	95.07	95.60	+0.53
	13	1.19	2.64	+1.45	6.12	5.85	-0.27	95.02	96.20	+1.18
	14	1.28	1.64	+0.36	10.55	10.15	-0.40	95.42	96.84	+1.42
Tape 3	15	1.03	0.82	-0.21	7.20	5.46	-1.74	96.85	96.68	-0.17
	16	1.27	1.18	-0.09	8.87	7.13	-1.74	94.68	94.63	-0.05
	17	0.87	1.48	+0.61	3.15	2.58	-0.57	94.34	94.52	+0.18
	18	1.36	1.34	-0.02	7.47	4.05	-3.42	96.32	96.01	-0.31
Tape 4	19	1.40	1.78	+0.38	3.05	3.21	+0.16	95.53	96.44	+0.91
	20	1.28	1.53	+0.25	9.39	4.21	-5.18	95.33	95.12	-0.21
	21	1.45	1.10	-0.35	32.46	13.01	-19.45	95.56	95.88	+0.32
	22	1.15	1.43	+0.28	14.89	7.81	-7.08	94.48	93.17	-1.31

for Subject 1. The biological limits of this variable for this subject may have not allowed any further decrease.

Subject 1 showed mixed directions in her TEMP mean difference data. Although nine of the sixteen mean differences were positive (Table 6), the overall mean difference was very slight (+0.15 degrees), indicating that the mean changes increased and decreased in equal amounts throughout the treatment phase. The graphed data (Figure 3) illustrates that the pre-training/post-training differences were of greater magnitude during Days 7-14 than during Days 15-22. This may suggest that Tapes 3 and 4 did not have as strong an influence physiologically on this subject, as did the first two tapes. Subject 1 may have been adjusting to the treatment during Tapes 1 and 2, as noted in her post-research questionnaire.

(3) The difference scores from Table 7 were used to compute correlations between the difference scores for each pair of physiological variables in Table 8. Positive yet insignificant correlations were found for each pair of variables for Subject 1. This only supports the expected direction for the EMG/EDA pair. It is interesting to note that the direction of the difference scores for EMG and TEMP shown in Table 7 was the same during Days 5-12 (Tapes 2 and 3). The correlation between EMG and TEMP difference scores ($r= +.44$) showed a moderate relationship (Table 8). This conflicts with the expectation that these variables would show a negative correlation. Peripheral temperature should increase during relaxation due to less constriction of the blood vessels resulting in increased blood flow. However, according to the correlations in Table 8, TEMP tended to decrease when EMG and EDA decreased. A possible explanation for this finding is that if the physiological variables have different reaction times to stimuli, this may have accounted for the results obtained in these data.

Table 9 shows the correlations between the pre-training means and the pre-training/post-training difference scores. These correlations were computed to determine what effect the value of the pre-training measurement had on the degree and direction of change revealed in the difference scores. For Subject 1, there was a very high negative correlation ($r= -.96$) for the EDA data. The lower the EDA pre-training measurement, the

Table 8
Correlations between Difference Scores of Physiological Measurements

	EMG/ EDA r	N	EMG/ TEMP r	N	EDA/ TEMP r	N
Subject 1	+.30	15	+.44	16	+.24	15
Subject 2	+.08	15	.10	16	-.17	15
Subject 3	+.01	15	-.04	16	+.17	15
Subject 4	-.33	15	+.24	15	+.06	15
Subject 5	-.09	15	+.09	15	-.08	15

Table 9
Correlations of Pre-Training Means with Pre-Training/Post-Training Difference Scores

	EMG	EDA	TEMP
Subject 1	-.58	-.96	-.33
Subject 2	-.36	-.38	-.34
Subject 3	+.45	-.27	-.15
Subject 4	-.86	-.33	+.03
Subject 5	-.36	-.56	-.51

greater was the difference score[11]. Thus, there were greater decreases in post-training EDA measurements when the pre-training measurements were higher. This finding strongly supports the Law of Initial Values.

(4) The physiological data were further examined to determine the relationship between self-reported stress level and the differences in the physiological measurements of stress level. The difference scores of the subject's ratings of unstressing sessions (RUS) before and after treatment were used for this analysis. Using these scores and the difference scores of the physiological measurements from Table 7, the cross-tabulation of these data is displayed in Table 10. For Subject 1, all ratings of unstressing sessions decreased after all treatment sessions, illustrating that the subject perceived herself as becoming more relaxed after the treatment sessions. On the other hand, she may have based her self-reported relaxation level on her belief of how unstressed she thought she was. Her replies to the post-research questionnaire revealed that she "was more alert and thinking more clearly" after listening to the relaxation tape. Physiologically, however, during ten of the sixteen sessions, the post-treatment EMG measurements showed an increase. In six of these cases, the increase was less than 0.40 Mvolts, which may have been too small to notice by an individual such as Subject 1, who was untrained in recognizing her own degree of muscle tension.

The same interpretation may apply to the only EDA measurement (Day 19) which increased after treatment. The increase of 0.16 mhos on this day may have been too small for the subject to recognize. The EDA data do show, with the exception of Day 19, a unanimous agreement between the direction of the self-reported stress level and that of the subject's electrodermal activity. It may be possible that this subject was psychologically and physiologically responding to her level of electrodermal activity, both of which show support for the hypothesized direction of change.

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[11] The range of the difference scores for Subject 1 was from -19.45 to +0.16 mhos. The negative correlation implies that as the pre-training measurements became larger, the difference scores actually increased along the negative end of the scale for the difference scores.

Table 10
Cross Tabulation:
Self-Report (RUS) with Physiological Pre/Post Differences

			EMG Up	EMG Down	EDA Up	EDA Down	TEMP Up	TEMP Down
Subject	RUS	Up	0	0	0	0	0	0
1		Same	0	0	0	0	0	0
		Down	10	6	1	14	9	7
Subject		Up	0	0	0	0	0	0
2	RUS	Same	1	2	1	2	2	1
		Down	10	3	3	9	4	9
Subject		Up	0	2	1	1	1	1
3	RUS	Same	0	2	1	0	1	1
		Down	0	8	3	5	6	2
Subject		Up	0	0	0	0	0	0
4	RUS	Same	0	0	0	0	0	0
		Down	1	5	1	5	6	0
Subject		Up	2	1	2	1	1	2
5	RUS	Same	3	1	4	0	2	2
		Down	5	2	6	1	5	2

* Missing data in both the self-report (RUS) and physiological data results in different totals within each of the blocks of data.

According to the literature, increased relaxation should cause an increase in peripheral temperature if the level begins low (Law of Initial Values). The TEMP data showed a discrepancy with only nine of the sixteen sessions showing agreement between the direction of the self-reported and physiological difference scores. Of the seven days in which the TEMP score decreased and the subject reported a decrease in stress, four were differences of less than 0.35 degrees, which may have been too small for the subject to recognize. Three of these four (Days 15, 17, and 18) were during Tape 3. The post-research questionnaire for this subject revealed that after Tape 3, she "was never totally relaxed". Her TEMP measurements may have reflected her feelings of uneasiness with the contents of Tape 3.

Summary

Since the instructional content of the treatment included muscle tension/relaxation exercises, a treatment effect was expected to occur in the EMG data. There was, however, no significant level or slope changes according to the statistical analysis.

There was a decrease in mean and variability level across the three phases of the study (baseline, treatment and post-treatment). Although the EMG change was not found immediately after the onset of treatment, it was seen as an effect over time on the subject's muscle tension prior to training. This has implications for the generalization of the treatment outside the laboratory. This also implies her ability to apply the unstressing training without the use of the taped instructions, as was further noted in her comment, "As I worked through the tapes, I became more independently able to relax".

The "relaxation response" was noted in the EDA data within treatment sessions (Table 7). The mean and variability decreased consistently throughout the fifteen treatment sessions (Table 6). The subject reacted positively to the treatment by recording a decreased stress level after each treatment session (both inside and outside of the laboratory). Psychologically, she perceived the unstressing training as having a positive effect on her. The self-report data correlated in all but one case[12] with the physiological electrodermal responses.

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[12] Data for Day 19 showed a very slight increase in EDA (+0.16 mhos), which may have been too small for the subject to recognize as such.

The increased level of variability within the EDA data may have been an underlying reason for these results. The higher levels of physiological response were found to correlate highly with the larger decreases in post-training measurements. This indicates that the more reactive physiological variable was the one that showed the "relaxation response" after treatment, as well as being the variable that the subject psychologically responded to through her self-reported stress levels.

Subject 2

(1) The EMG measurements for Subject 2 showed a consistency within sessions and across all phases of the study (Figure 4)[13]. The low EMG means and variabilities for this subject confirmed her own comment that "I am generally not a very tense person". There was only one EMG pre-training mean of 0.77 Mvolts (Day 9), which was (very slightly) above the mean baseline level of 0.76 Mvolts. There was statistically a significant level change in the treatment phase (Table 3). The post-treatment scores showed a maintenance of the low level of muscle tension with the mean (0.62 Mvolts) being slightly lower than that of the pre-training phase (0.64 Mvolts) (Table 2).

Although there was no significant effect of the treatment on EDA measurements of Subject 2, self-report data helped to explain the two high points of the data during the treatment phase. On Day 12 (Figure 5), one of the high peaks of EDA measurements, it was noted that the subject had a presentation to give in a class later in the day. Prior to the testing session on Day 20 (noted as another high EDA measurement), the subject had just received a poor grade on a paper. These events may have been responsible for the increased EDA on these days. As did the EMG data, EDA data in the post-treatment phase suggest a continuation of the same pattern as that of the pre-training data.

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[13] Due to the low level of EMG scores and the 0.5 increments of the measurement scale, some of the post-training data points on the graph in Figure 4 are concealed by the pre-training data points.

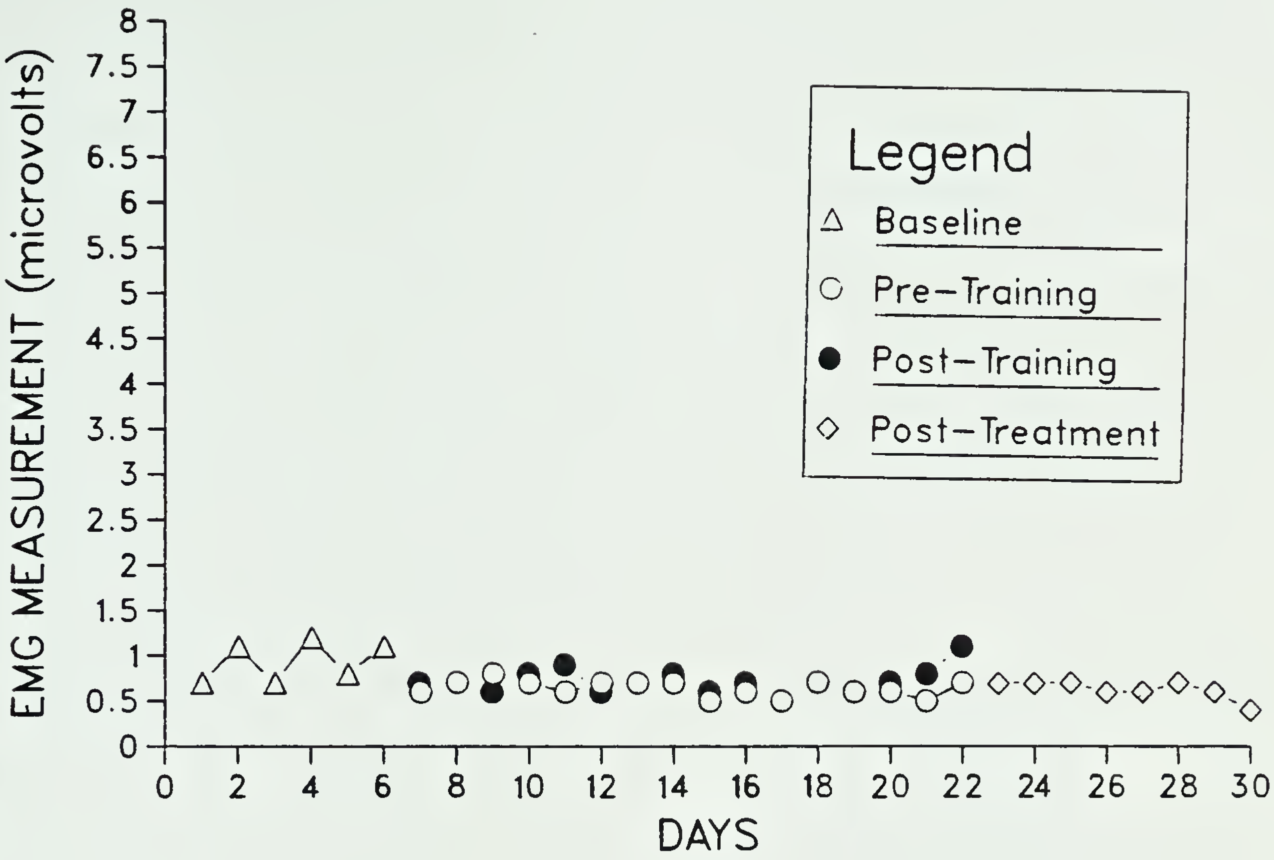

Figure 4. Daily EMG Means: Subject 2

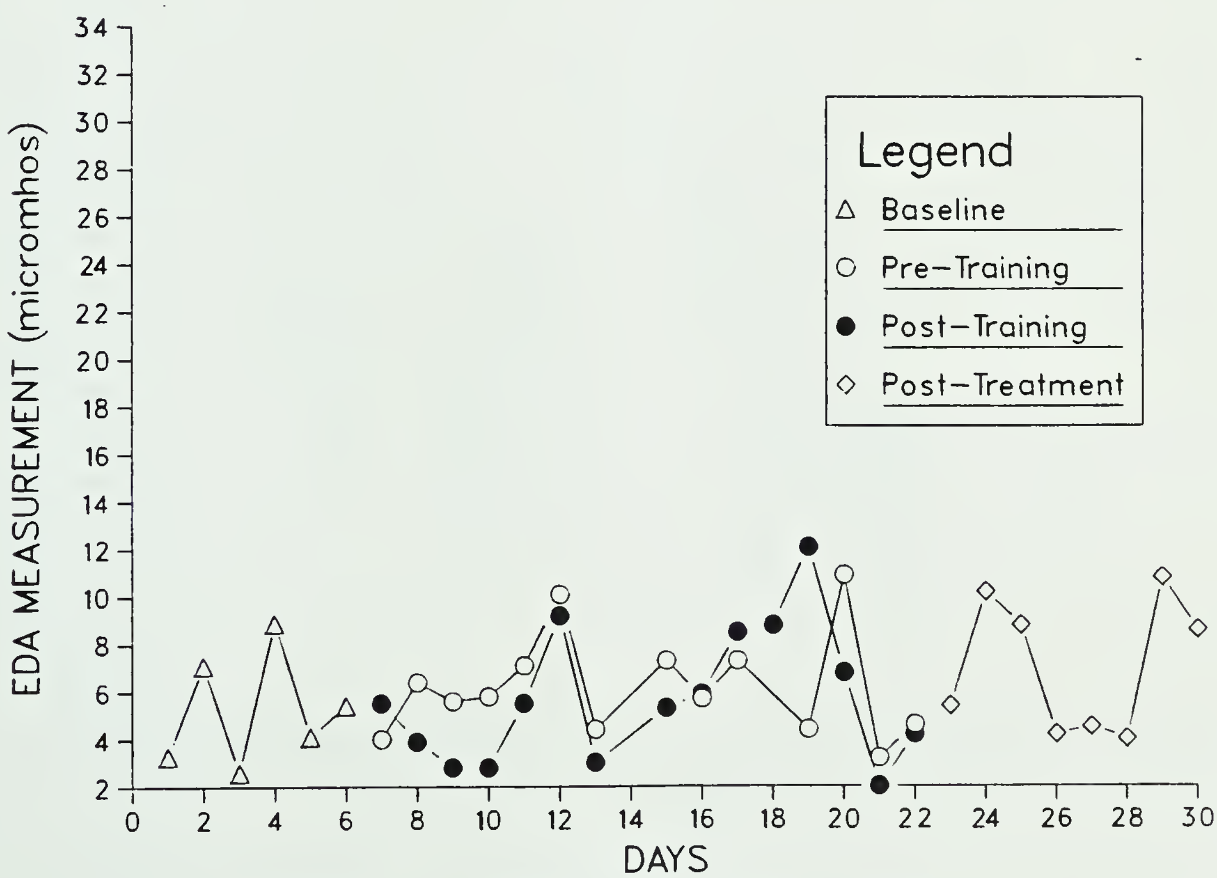

Figure 5. Daily EDA Means: Subject 2

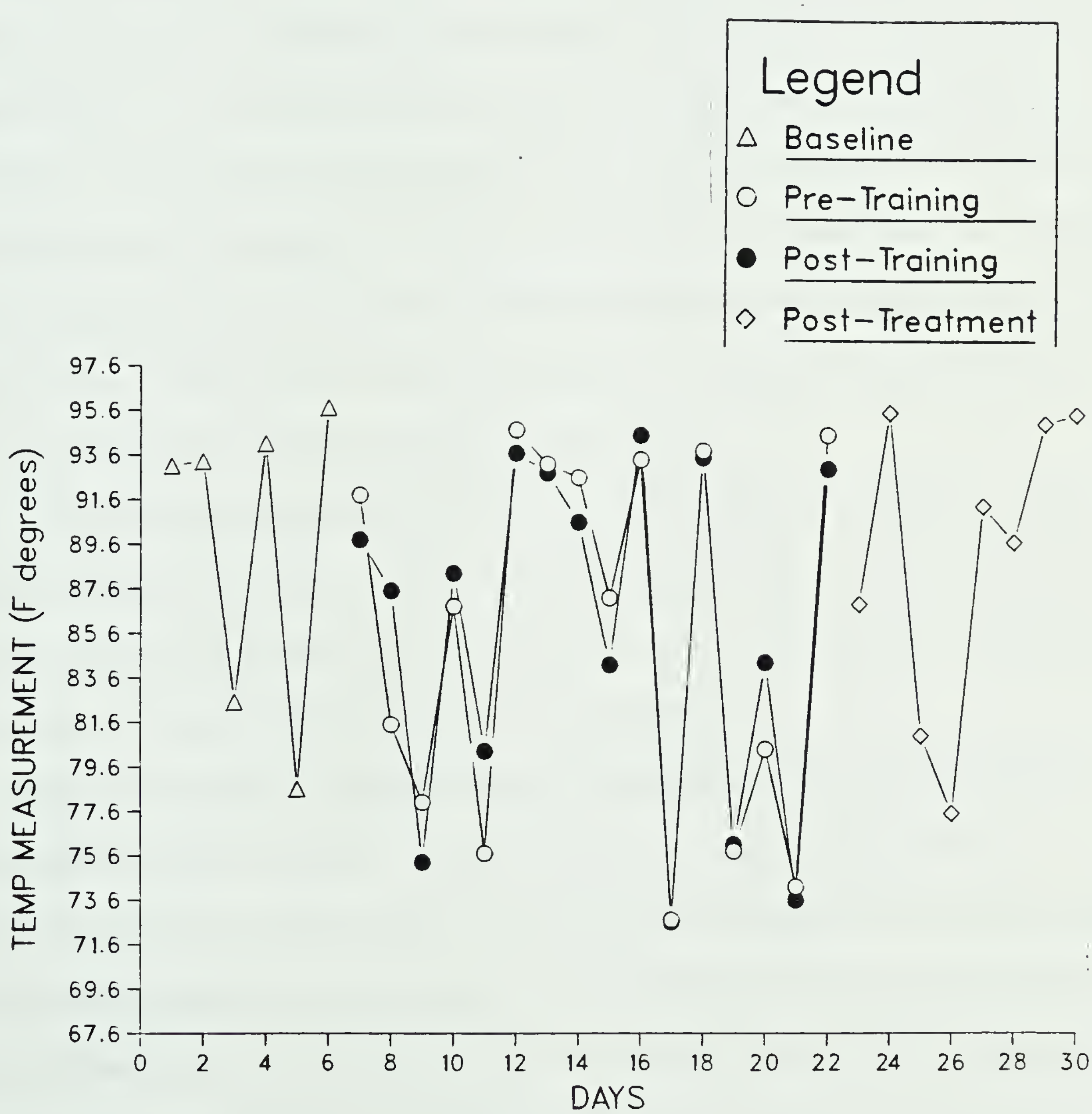

Figure 6. **Daily TEMP Means: Subject 2**

The variable TEMP data for Subject 2 did not show any significant effects from the treatment. Nine of the sixteen means during the pre-training phase were below the baseline mean indicating an increase in stress level during more than half of the treatment sessions.

(2) Within the treatment phase, the comparison of the pre-training with the post-training measurements examines the physiological effect of the treatment on the subject. The EMG data revealed an increase in the mean of the post-training sessions, with eleven of the sixteen post-training means being higher than the baseline mean (Table 6). All the pre-training means were very low, ranging from 0.47 to 0.77 Mvolts. The possibility of a "floor effect", which would not allow much further decrease in tension level, may have influenced these results. The increases in muscle tension after treatment were slight (<0.35 Mvolts) (Table 11). These small differences may be misleading when merely examining the total number of mean increases versus decreases. On Days 15 - 18 (Tape 3), all the EMG and EDA difference scores were positive, reflecting an increase in muscle tension and electrodermal activity after treatment. Self-report data revealed that Subject 2 expressed a particular dislike for Tape 3 because "there was too much to concentrate on". This may have been a causal factor in the increased mean differences during these sessions.

The same trend was observed in the EDA means for Days 15 - 18 (Table 11). These data may have reflected the subject's uneasiness with that particular tape. Figure 5 illustrates that the only other EDA mean that increased in post-training occurred on Day 1, which may have been due to the novelty effect of the first day of treatment.

The pre-training/post-training difference scores of TEMP showed mixed directions with no apparent pattern (Table 11). Figure 6 illustrates the high variability of the pre-training and the post-training means. The extremely small difference in the overall means of the two phases (Table 6) was supported by the small differences between most of the pre- and post-training means within session. Subject 2 expressed a dislike for Tape 3, which may have accounted for the decrease of 3.01 degrees during Day 15 and for the lack of change in TEMP measurements from pre-training to post-training during Days 17 and 18.

Table 11
Difference between Pre-training and Post-training Physiological Means:
Subject 2

		EMG			EDA			TEMP		
	Day	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff
Tape 1	7	0.61	0.73	+0.12	4.04	5.45	+1.41	91.78	89.75	-2.03
	8	0.73	0.70	-0.03	6.36	3.88	-2.48	81.51	87.48	+5.97
	9	0.77	0.62	-0.15	5.58	2.79	-2.79	78.00	75.25	-2.75
	10	0.74	0.79	+0.05	5.81	2.83	-2.98	86.78	88.33	+1.54
Tape 2	11	0.59	0.85	+0.26	7.06	5.53	-1.53	75.73	80.33	+4.60
	12	0.68	0.58	-0.10	10.17	9.22	-0.95	94.69	93.72	-0.97
	13	0.69	0.68	-0.01	4.36	3.02	-1.34	93.20	92.76	-0.44
	14	0.66	0.77	+0.11	7.34	5.26	-2.08	92.61	90.62	-1.99
Tape 3	15	0.54	0.57	+0.03	5.67	5.89	+0.22	87.16	84.15	-3.01
	16	0.58	0.72	+0.14	7.33	8.48	+1.15	93.37	94.52	+1.15
	17	0.47	0.52	+0.05	----	----	----	72.74	72.58	-0.16
	18	0.71	0.74	+0.03	4.40	12.06	+7.66	93.79	93.48	-0.31
Tape 4	19	0.64	0.62	-0.02	10.87	6.78	-4.09	75.80	76.11	+0.31
	20	0.64	0.72	+0.08	3.21	1.97	-1.24	80.42	84.34	+3.92
	21	0.51	0.80	+0.29	4.24	4.21	-0.35	74.17	73.61	-0.56
	22	0.73	1.08	+0.35	5.42	3.48	-1.94	94.47	93.04	-1.43

(3) The correlations implying the degree of interrelationship between the difference scores of the physiological variables for Subject 2 were very small as shown in Table 8. The correlation between the pre-training means and the pre-training/post-training difference scores (Table 9) does not support the Law of Initial Values for any of the physiological variables. The difference scores were not influenced by the level of the pre-training score. The strongest relationship that was found within the individual sessions was that of Days 15 - 18, which showed a negative response to Tape 3 on EMG, EDA and three of the four days on TEMP. Data for Day 19 showed a relationship between high EDA and low TEMP post-training responses to the treatment. This was the first day of Tape 4, to which the subject responded that "the first time I heard the tape...{it} made me all tense...but after a couple of times, I got things under control". The EDA and TEMP responses to that first day of Tape 4 indicate a stress response. The EDA data further supported this feeling by showing post-treatment decreases during the following treatment sessions in which Tape 4 was used (Days 20, 21, and 22). The self-report data for Days 19-22 correlated with the EDA responses by reporting no change after treatment on Day 19 and decreased stress level after treatment on Days 20-22.

(4) It was expected that the physiological changes would correlate with the self-reported stress level changes within session. For Subject 2, three of the sixteen RUS scores remained the same after treatment, two of which were associated with extremely small differences in muscle tension (-0.01, -0.02 Mvolts) (Table 10). The pre-training EMG measurements for Subject 2 were all very low, implying that there was little opportunity to decrease much more. Thus, the tabulated numbers in Table 10 may be misleading. Of the thirteen RUS scores that decreased, ten were accompanied by increases in muscle tension. However, these difference scores ranging from +0.03 to +0.35 Mvolts may have been too small for the subject to recognize as increased muscle tension.

The observational data, recorded by the researcher in the laboratory treatment sessions, revealed some interesting data for Days 19 and 21. Subject 2 reported feeling "more tense" after treatment on Day 19, and after treatment on Day 21 she felt "more relaxed than ever

before". These self-reports were supported by the EDA data for these days. Further examination of the correlation between RUS and EDA revealed that three of the four EDA scores that increased and were accompanied by a decrease or no change in RUS, were found during Tape 3 (Days 15, 16, and 18). This discrepancy between the actual physiological reaction and the personal evaluation of her feelings may have been due to her dislike of this tape, noted in the post-research questionnaire, which resulted in increased electrodermal activity. The other instance of increased EDA and decreased RUS was on Day 7, the first day of treatment.

The TEMP difference scores showed a mixed representation within the cross-tab matrix. Only four of the sixteen pairs supported the expected increase in TEMP with a decrease in self-reported relaxation level. There seemed to be no apparent patterning to explain the discrepancy between TEMP and RUS scores in these instances.

Summary

The EMG measurements for Subject 2 showed that across time she learned to decrease her level of muscle tension. This significant level change indicates that she was able to further reduce the already low level of the EMG measurements. The pre-training measurements indicate the lag time for the subject to become familiar with the treatment procedure was approximately two weeks, which encompasses the time spent on Tape 1 (Days 7-10). The post-research questionnaire data revealed that Subject 2 viewed Tape 1 as "easy to relate to...{and} a good way to begin to learn how to relax".

Although there was a positive long-term effect of the treatment as shown by the decreasing trend of EMG measurements from baseline through post-treatment, the opposite trend was evident in the comparison of the pre-training measurements to the post-training measurements within each treatment session. This discrepancy may be explained in terms of dysponetic tendencies of Subject 2. Her need to personally achieve the most out of the treatment may have resulted in increased effort and consequently increased trapezius muscle tension. The post-research questionnaire data supported this hypothesis. Subject 2 felt that

while using Tape 2, she "never knew if {she} was minimally tensing or overdoing it". Introducing biofeedback into the training session would have allowed the subject to become aware of the degree of muscle tension at any particular time. She was uncomfortable with Tape 3, because "there was too much to concentrate on...{and} the next thing I knew, I {wasn't} concentrating on relaxing anymore".

Her uneasiness with Tape 3, revealed through the post-research questionnaire, was also noted in her EDA measurements. With the exception of the first days of Tape 1 and Tape 4, the post-training EDA measurements for Days 16, 17, and 18 (Tape 3) were the only ones recorded for Subject 2 which showed an increase over the measurements prior to treatment on those days. There were no treatment effects noted from the EDA and TEMP results for Subject 2.

Subject 3

(1) She was the only subject to show a significant level change and drift change between the baseline and treatment phases (Table 3). Only five of the sixteen pre-training means were above the level of the baseline mean of 1.62 Mvolts. The three which exhibited the highest pre-training means were Days 7, 8, and 9, the first three days of treatment. Subject 3 may have been reacting to the novelty of the treatment. A small increase was noted on Day 22, when the subject was noted as being active, excited and fidgety during the testing session. Subject 3 described herself as being a "nervous" person at times, as revealed in the post-research questionnaire. This disposition may have accounted for the high level of muscle tension noted in the pre-training measurement on this day.

No significant level or drift change was found in the EDA data for Subject 3. The increased EDA means and variability in the pre-training phase were supported by ten of the pre-training data points being greater than the baseline mean (Table 2).

The majority of the sixteen pre-training TEMP means fell below the level of the baseline mean (Table 2), also suggesting no positive effect of the treatment on the peripheral

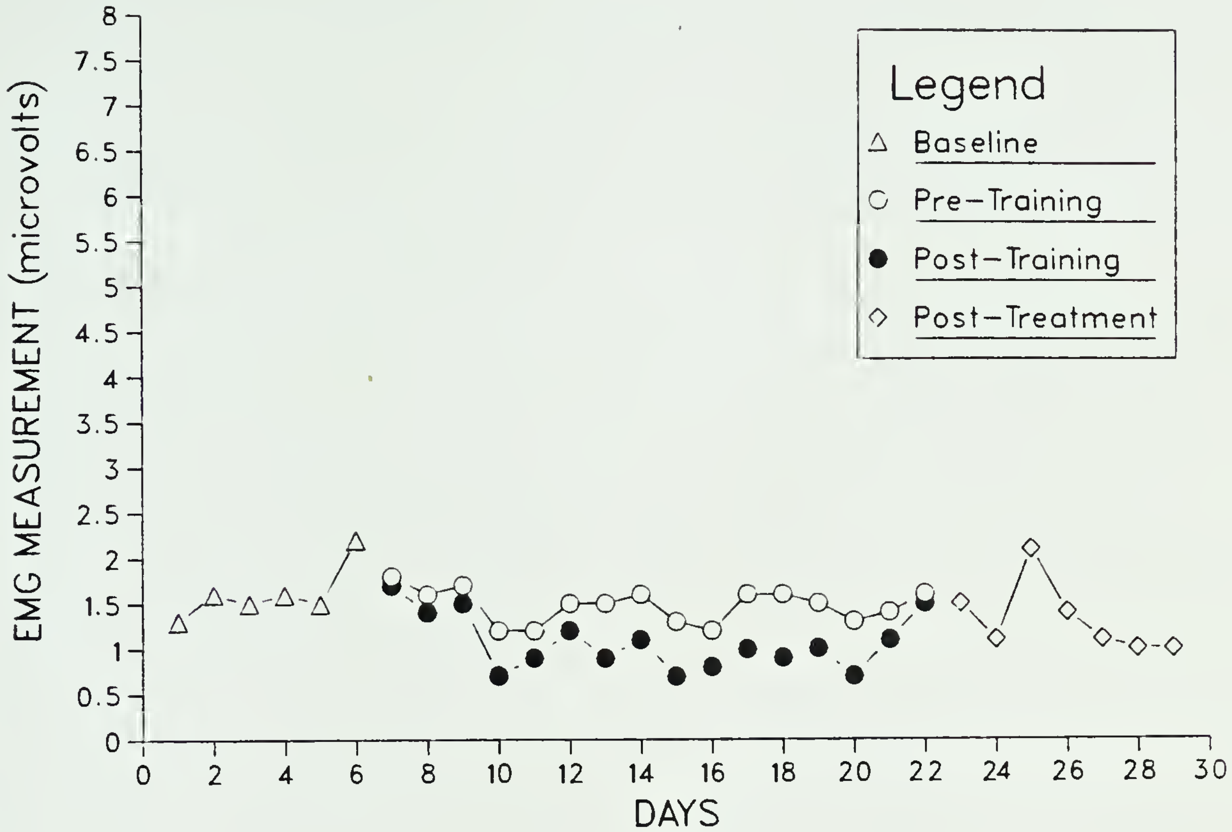

Figure 7. Daily EMG Means: Subject 3

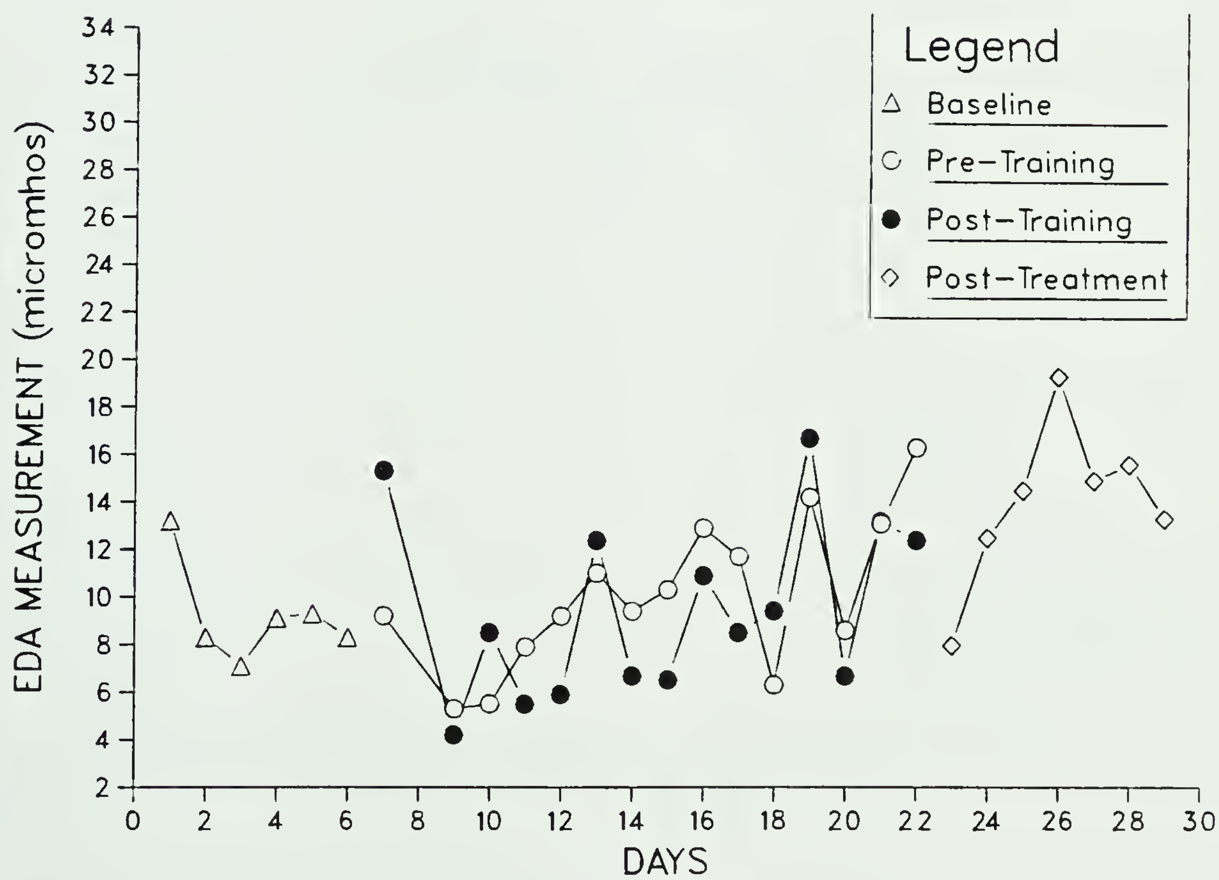

Figure 8. Daily EDA Means: Subject 3

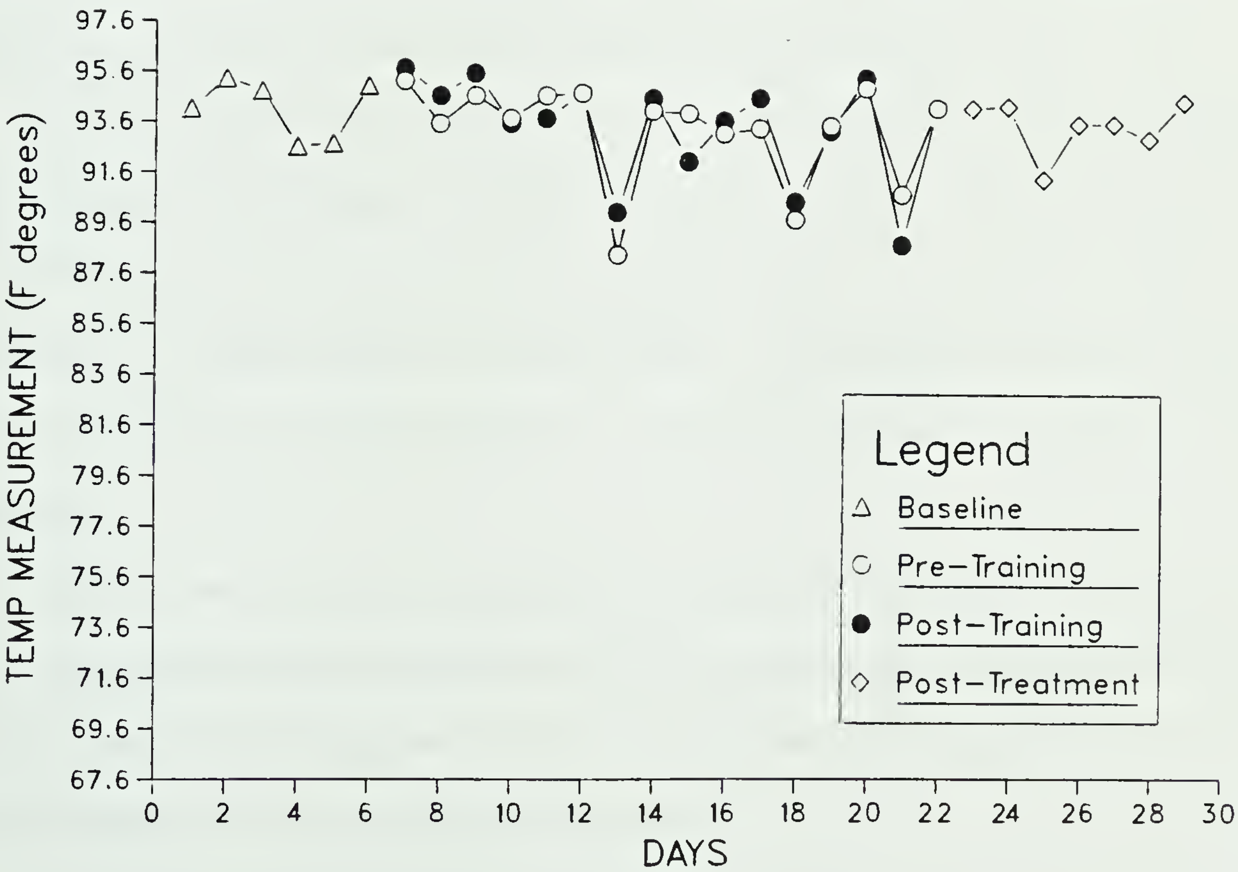

Figure 9. Daily TEMP Means: Subject 3

temperature level of Subject 3 (Figure 9).

These data do not reflect an increase in TEMP and a decrease in EDA associated with relaxation, as suggested in the literature. Either these two systems did not respond to this particular treatment as a form of relaxation, or the subject was dependent upon the taped instructions to achieve a state of relaxation.

(2) The previous results and explanations for each physiological variable seems to be reinforced by the data of the pre-training/post-training measurements (Table 6). There was a pronounced decrease in the EMG post-training overall mean. All the post-training means were below the pre-training mean level (Table 12). This shows strong evidence that the treatment effected a reduction in muscle tension in Subject 3.

According to the overall EDA means, there was decreased electrodermal activity after treatment (Table 6). However, examination of the means within each session revealed that only nine of the fifteen post-training means were less than the pre-training mean of the same session. The days showing increased EDA followed no pattern (Table 12), supporting a random effect that cannot be confidently accounted for by the treatment alone.

Eleven of the sixteen TEMP means showed an increase following treatment (Table 6). The overall means did not reflect a difference between pre-training and post-training means. Table 12 shows that three of the means that decreased, (Days 11, 15, and 19) were the first day of a new tape. The other two days showing decreases in post-training TEMP measurements were Day 10, showing a very slight decrease of -0.25 degrees, and Day 21, for which there is no explanation.

(3) There was no apparent interrelationship among the physiological variables (Table 8). A +0.45 correlation between EMG pre-training means and the pre-training/post-training difference scores shows that the level of the pre-training mean had very little effect on the degree of change in the post-training means (Table 9).

(4) The comparison of the physiological and self-reported stress levels (RUS) during the treatment phase were tabulated in Table 10. All of the EMG difference scores for Subject 3

Table 12
Difference between Pre-training and Post-training Physiological Means:
Subject 3

		EMG			EDA			TEMP		
	Day	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff
Tape 1	7	1.78	1.71	-0.07	9.18	15.26	+6.08	95.22	95.70	+0.48
	8	1.64	1.35	-0.29	----	----	----	93.52	94.56	+1.04
	9	1.66	1.49	-0.17	5.32	4.24	-1.08	94.62	95.52	+0.90
	10	1.18	0.66	-0.52	5.49	8.53	+3.04	93.70	93.45	-0.25
Tape 2	11	1.21	0.87	-0.34	7.91	5.49	-2.42	94.60	93.74	-0.86
	12	1.46	1.18	-0.28	9.23	5.90	-3.33	94.68	94.74	+0.06
	13	1.45	0.86	-0.60	10.96	12.43	+1.47	88.31	90.00	+1.69
	14	1.45	1.14	-0.31	9.35	6.66	-2.69	93.99	94.49	+0.50
Tape 3	15	1.31	0.72	-0.59	10.30	6.54	-3.76	93.94	92.00	-1.94
	16	1.18	0.83	-0.35	12.92	10.91	-2.01	93.12	93.57	+0.45
	17	1.59	0.98	-0.61	11.66	8.51	-3.15	93.27	94.52	+1.25
	18	1.55	0.91	-0.64	6.25	9.38	+3.13	89.68	90.36	+0.68
Tape 4	19	1.44	1.01	-0.43	14.21	16.65	+2.41	93.41	93.17	-0.24
	20	1.34	0.72	-0.62	8.62	6.66	-1.96	94.92	95.32	+0.40
	21	1.42	1.11	-0.31	13.11	13.17	+0.06	90.73	88.67	-2.06
	22	1.64	1.53	-0.11	16.27	12.42	-3.85	94.06	94.13	+0.07

reflected decreased post-training means. During two of the twelve sessions used in the analysis, the subject reported increased stress levels following treatment. These were on the first two days of Tape 4 (Days 19 and 20). On the third day of this tape (Day 21), the subject reported that her stress level remained the same. Perhaps, the content of Tape 4 initiated a feeling of increased stress for this individual until she became more familiar with the contents of the tape, thereby feeling more at ease while listening to it. The other session during which there was no reported change in level of unstressing was Day 8, perhaps the result of the subject's adjustment to the treatment.

Only six of the eleven pairs of scores (RUS with EDA) showed a positive correlation. Of the remaining five, one session (Day 21) was reported by Subject 3 as having no change in her level of stress and matched by relatively no change in electrodermal activity (+0.06 mhos). The other four discrepancies (Days 7, 10, 18, and 20) followed no apparent pattern. Thus, any changes cannot be attributed to the treatment.

Seven of the twelve TEMP and RUS pairs of scores supported the negative correlation of increased peripheral temperature accompanied by a decreased self-reported stress level. There seemed to be no logical sequence to explain the other five discrepant pairs of scores.

Summary

There was a very clear treatment effect on muscle tension level of Subject 3. All the EMG means decreased after treatment. It appears from the data that the first three treatment days (1 1/2 weeks) were needed as an adjustment period to the treatment protocol. Accounting for this adjustment period, her pre-training muscle tension level was above the baseline level on only one occasion, when observational data revealed the subject to be fidgety during the treatment session. This implies that the subject was not dependent upon the taped instructions to induce a reduction in her trapezius muscle tension.

The self-report data showed a positive relationship to the EMG data. Disregarding data for one of the adjustment days (Day 8), and that of Tape 4 (Days 19, 20, and 21), the other self-report data was consistent with the EMG data results. These findings may have been

influenced by the fact that in addition to all the EMG means showing a decrease, the subject knew she was "supposed to" feel more relaxed after treatment. However, the subject stated in the post-research questionnaire that "the {treatment} sessions were very relaxing...they helped to relax both the mind and body".

Although the correlational data revealed no substantial interrelationships among the physiological variables, data on several days did show physiological responses indicating a directional consistency with respect to the expected relaxation/stress response. The EMG/EDA relationship was demonstrated by the high pre-training measurements on Day 22, and the high post-training measurements on Day 7. The high EDA and low TEMP post-training measurements on Day 13 reinforced the expected reciprocal relationship between these two variables. These were not found elsewhere in the data, and therefore cannot be attributed to the treatment. If this relationship does in fact exist, other factors must have confounded the results of these data. It was mentioned before that perhaps the physiological responses must be more extreme to obtain a consistent and significant relationship between the physiological variables.

Subject 4

(1) Observing the trend of the EMG means across time (Table 2), thirteen of the pre-training means for Subject 4 were lower than the level of the baseline mean (Figure 10). One of the two pre-training means above the baseline level was on Day 13, most likely a result of adjustment to the treatment. A very slight increase above baseline mean (+0.04 Mvolts) on Day 23 accounted for the other high pre-training mean. However, the statistical analysis and visual analysis of the data did not show any significant decrease in level of EMG. The statistical analysis revealed a significant increase in level between the end of the baseline phase and the beginning of the pre-training phase (Table 3).

The lack of any significant change in EDA measurements was further supported by only eight of the fifteen pre-training means being below the overall baseline level. The high

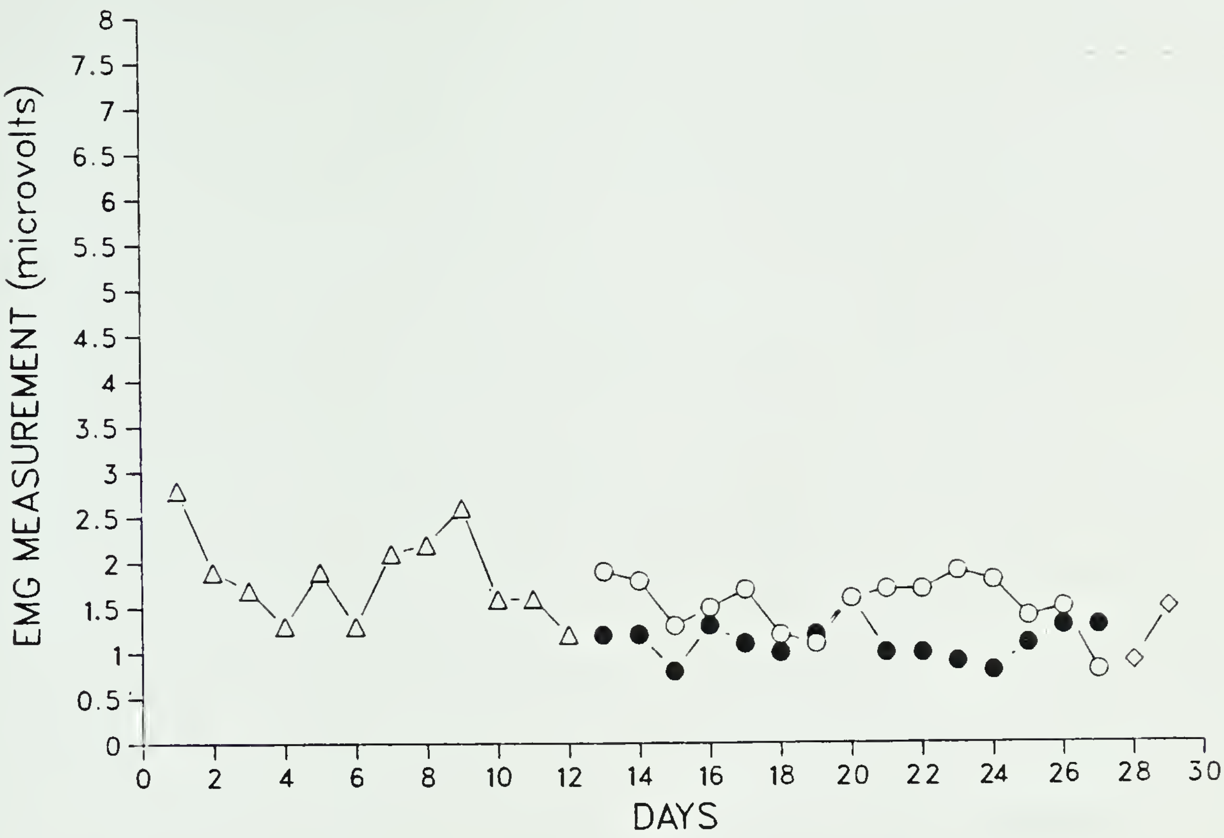

Figure 10. Daily EMG Means: Subject 4

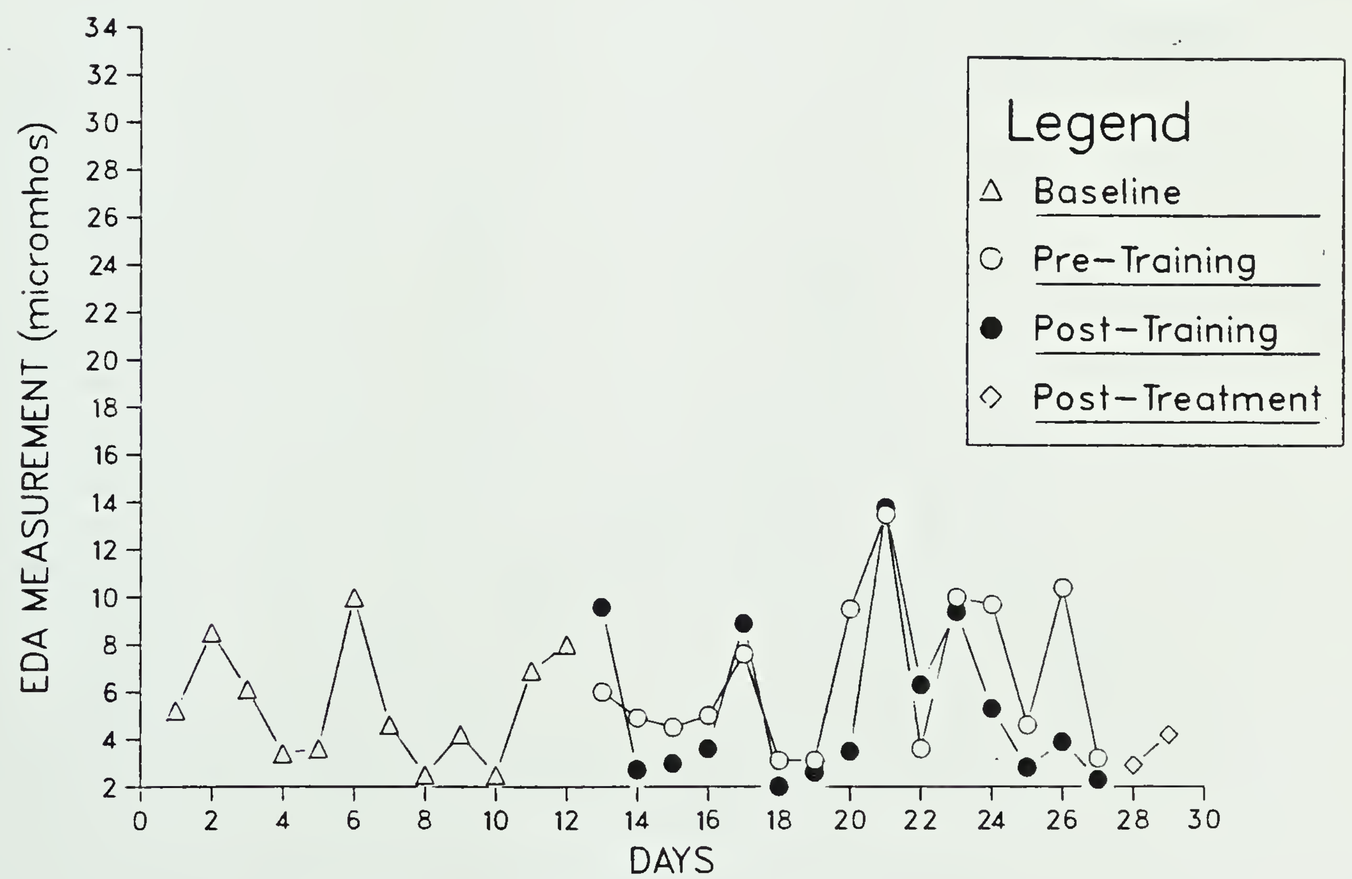

Figure 11. Daily EDA Means: Subject 4

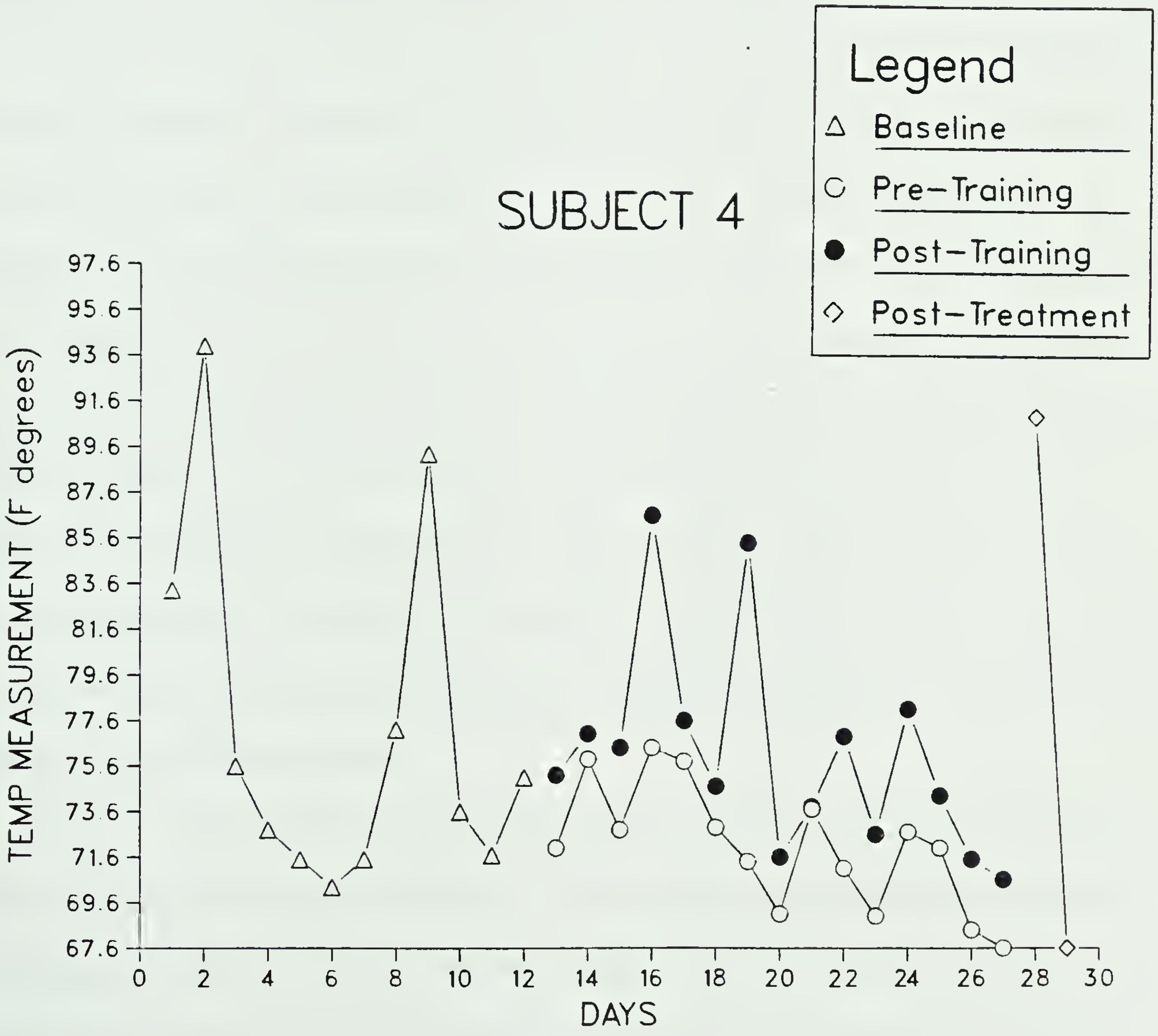

Figure 12. Daily TEMP Means: Subject 4

peak in the pre-training phase (Day 21) occurred on the first day of Tape 3, perhaps a novelty effect. Little evidence in these data supported any treatment effect.

The TEMP data also showed no treatment effect. Only three of the fifteen pre-training means were higher than the baseline mean showing the relaxation response (Table 2). Either the treatment did not affect the temperature response system or the subject did not apply the technique without the taped instructions toward herself in a way that would affect her peripheral temperature (Table 2).

(2) The comparison of EMG pre-training to post-training scores showed evidence of a positive affect of the treatment. Table 6 shows that the overall means decreased and the variability of both the pre-training and post-training means were very low. Only two of the means showed an increase in post-training muscle tension (Table 13). One of these (Day 19) was a very small increase (0.02 Mvolts). The one-minute averages for Day 19 showed a rather high average for minute 1 of the post-training measurements, which then dropped to a rather stable level (1.08 Mvolts) for the remaining four minutes. Excluding the first minute measurement, the data suggested that the subject was able to reduce her muscle tension during the post-training period. The other increase occurred during the last laboratory treatment session (Day 27), wherein the pre-training mean was the lowest of any pre- or post-training mean for this subject. The post-training value on Day 27 was not out of range with the previous two post-training means during Tape 4. The content of this tape, being unstressing instructions while mentally performing the preparatory movements for one of the performance skills, may have resulted in Subject 4 unconsciously tensing her trapezius muscle slightly while listening to the tape (Jacobson 1938).

The EDA measurements showed some support for a positive effect of the treatment, although statistically there was no significance. The overall means dropped slightly from 6.58 mhos during pre-training to 5.28 mhos in post-training. Figure 11 illustrates that the first day of Tapes 1, 2, and 3 showed a higher post-training mean than the following days, revealing a possible novelty effect. These (Days 13, 17, and 21) also accounted for three of the four

Table 13
Difference between Pre-training and Post-training Physiological Means: Subject 4

		EMG			EDA			TEMP		
	Day	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff	Pre-trg Mean	Post-trg Mean	Diff
Tape 1	13	1.94	1.18	-0.76	6.03	9.55	+3.52	71.97	75.24	+3.27
	14	1.81	1.24	-0.57	4.91	2.68	-2.23	75.91	76.96	+1.05
	15	1.31	0.82	-0.49	4.45	2.97	-1.48	72.79	76.35	+3.56
	16	1.46	1.34	-0.12	5.03	3.57	-1.46	76.40	86.57	+10.17
Tape 2	17	1.74	1.07	-0.67	7.57	8.87	+1.30	75.78	77.64	+1.86
	18	1.21	1.00	-0.21	3.10	1.86	-1.24	72.91	74.70	+1.79
	19	1.13	1.15	+0.02	3.08	2.55	-0.53	71.43	85.35	+13.92
	20	1.60	1.60	0.00	9.48	3.51	-5.97	69.11	71.62	+2.51
Tape 3	21	1.70	1.00	-0.70	13.47	13.82	+0.35	73.73	73.78	+0.05
	22	1.68	1.01	-0.67	3.61	6.32	+2.71	71.06	76.85	+5.79
	23	1.88	0.90	-0.98	9.97	9.36	-0.61	68.98	72.64	+3.66
	24	1.77	0.84	-0.93	9.67	5.27	-4.40	72.69	78.10	+5.41
Tape 4	25	1.39	1.13	-0.26	4.61	2.75	-1.86	71.95	74.34	+2.39
	26	1.46	1.34	-0.12	10.43	3.88	-6.55	68.40	71.48	+3.10
	27	0.78	1.30	+0.52	3.23	2.28	-0.95	67.48	70.55	+3.07
	28	----	----	----	----	----	----	-----	-----	-----

increased means from pre-training to post-training. The high peak on Day 21 was unaccounted for.

The TEMP measurements in Figure 12 also show that there was a treatment effect for Subject 4. All the post-training means increased over the pre-training means with the overall average of the post-training means greater than the pre-training mean by 4.10 degrees (Table 6). Although the variability of the post-training means increased, the graphed data illustrates this to be caused by several high peaks, specifically on Days 16 and 19. This demonstrates an increased blood flow that is associated with the relaxation response. Looking across physiological variables on Day 19, the large increase in TEMP was accompanied by a low EMG level that remained low through post-training, and a low EDA measurement that decreased during post-training. Subject 4 also reported a decrease in her stress level on this day. Data for Day 16 showed a similar pattern with a slight decrease of EMG and a decrease in EDA along with the large increase in TEMP. Self-report data were not available from Subject 4 on this day. These data suggest that perhaps the extreme responses show a more definitive pattern across variables (Lacey and Lacey 1958). The smaller fluctuations and changes may conceal this interrelationship.

(3) The correlations between the difference scores of the physiological variables did not reveal any significant correlations (Table 8). Although the correlations were low, the direction of each one was opposite to that expected to coincide with the relaxation response. Muscle tension and electrodermal activity should decrease, while peripheral temperature simultaneously increases. These low correlations do not provide supportive evidence of any of these expected responses.

Table 9 shows a rather substantial correlation (-0.86) between EMG pre-training means and the corresponding difference scores. This negative correlation indicates that the larger the EMG pre-training mean, the larger was the reduction in the post-training mean. This finding supports the the Law of Initial Values, which predicts that there will be greater changes when the initial score, (pre-training mean in this case), is at the upper or lower

extreme of the biological limits for that physiological variable.

(4) Due to missing self-report data for Subject 4, there were only six pairs of scores used in the analysis comparing self-report to physiological data. Five of the six pairs comparing EMG and self-reported stress level supported the expected positive correlation. The one discrepancy occurred on Day 19 when there was a +0.02 Mvolt change in EMG with a self-reported decrease in stress level. Five of the six EDA/RUS pairs of scores also supported a positive correlation. The one pair that was discrepant was on Day 13, which may have been due to the novelty factor of the treatment. The relationship of TEMP difference scores to self-reported stress levels for Subject 4 unanimously supported a negative correlation, in agreement with the expected physiological response to increased relaxation.

Summary

The data for Subject 4 showed that the treatment had a noticeable immediate effect on reducing trapezius muscle tension and increasing the level of peripheral temperature. The post-treatment measurements responded in the direction associated with the relaxation response (i.e. decreased muscle tension and increased temperature). The initial measurements within each session showed the temperature data to be at a relatively low level throughout the study. The pre-training TEMP scores, however, had no relationship to the intensity of change in the post-training measurements. This was not the case with the EMG data. The higher pre-training EMG measurements correlated with the greater decreases in the post-training EMG measurements. There was a significant increase in EMG level found at the onset of the treatment phase due to the downward trend in muscle tension during the baseline phase. Therefore, these data did not show that the subject was able to effectively decrease her trapezius muscle tension without the use of the unstressing tapes.

Subject 4 seemed to be quite aware of her physiological changes. Her self-reported stress levels were highly correlated with the physiological changes that occurred after treatment.

There was no consistent relationship among the physiological variables that supported the "relaxation response". There were several instances when a pair of physiological variables

reacted in a manner representative of the relaxation response. The relaxation response was supported by the post-training EMG and TEMP data on Days 26 and 27, the baseline EDA and TEMP data on Day 6, the post-training EDA and TEMP data on Day 23, and the pre-training EMG and EDA data on Day 24. The one instance when all the three physiological variables were interrelated was the pre-training data on Day 23. These data showed high[14] pre-training EMG and EDA values and a low TEMP value. There was no observational data for Day 23 to determine the reason for this occurrence.

Subject 5

(1) Although there was no statistical evidence of a treatment effect on EMG, the data showed a decrease in means from baseline to pre-training. A closer examination of the data in Table 14 revealed that only one mean (Day 24) was greater than the overall baseline mean level. There was no explanation from the available data for this high point in the pre-training data. The scores for Days 1-4 indicated a period of adjustment to the treatment (Figure 13), after which there was a plateau of the EMG means. In Figure 13, there does not appear to be much change in the level of the stabilized baseline means (Days 5-12) and the pre-training means.

The EDA data supported a negative effect of the treatment on Subject 5. The overall means increased from baseline to pre-training and all of the pre-training means were greater than the overall baseline mean level. In viewing Figure 14, it can be seen that the upward trend of baseline means was continued throughout the pre-training phase until Day 23 when the level dropped slightly and plateaued. The high peak during baseline (Day 11) may have represented the subject's response of anticipation to an exam in her next class.

A significant increase was found in the level of TEMP between baseline and treatment phases. The graphed data in Figure 15 show that there were almost an equal number of

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[14] The terms *high* and *low* were used in reference to the other data points within the particular phase. (i.e. A high pre-training EMG data point would signify one of the highest peaks within the pre-training EMG data points for that subject.)

Table 14
Difference between Pre-training and Post-training Physiological Means: Subject 5

	Day	EMG Pre-trg Mean	EMG Post-trg Mean	EMG Diff	EDA Pre-trg Mean	EDA Post-trg Mean	EDA Diff	TEMP Pre-trg Mean	TEMP Post-trg Mean	TEMP Diff
Tape 1	13	1.19	1.38	+0.19	6.32	14.05	+7.73	93.55	90.38	-3.17
	14	1.13	6.30	+5.17	7.80	10.72	+2.92	91.19	91.22	+0.03
	15	1.30	1.47	+0.49	7.61	10.72	+3.11	95.25	92.87	-2.38
	16	1.40	1.35	-0.12	7.02	7.68	+0.66	92.59	91.09	-1.507
Tape 2	17	1.45	1.15	-0.30	8.31	11.08	+2.77	92.32	90.16	-2.16
	18	0.96	1.23	+0.27	7.79	8.94	+1.15	93.59	93.84	+0.25
	19	1.31	1.50	+0.19	8.83	10.77	+1.94	91.93	92.46	+0.53
	20	1.39	1.27	-0.12	10.32	13.24	+2.92	93.79	94.97	+1.18
Tape 3	21	1.11	1.54	+0.43	13.54	12.23	-1.31	93.78	95.27	+1.49
	22	1.36	1.61	+0.25	12.72	13.34	+0.62	94.43	94.45	+0.02
	23	1.13	2.14	+1.01	9.31	8.16	-1.15	92.80	93.88	+1.08
	24	2.05	1.28	-0.77	7.98	14.72	+6.74	93.52	92.13	-1.39
Tape 4	25	0.96	1.62	+0.66	8.45	14.07	+5.62	94.84	94.72	-0.12
	26	0.99	1.43	+0.44	9.31	11.33	+2.02	94.55	95.53	+0.98
	27	1.03	1.30	+0.27	8.16	9.44	+1.28	89.39	94.91	+5.52
	28	----	----	----	----	----	----	-----	-----	-----

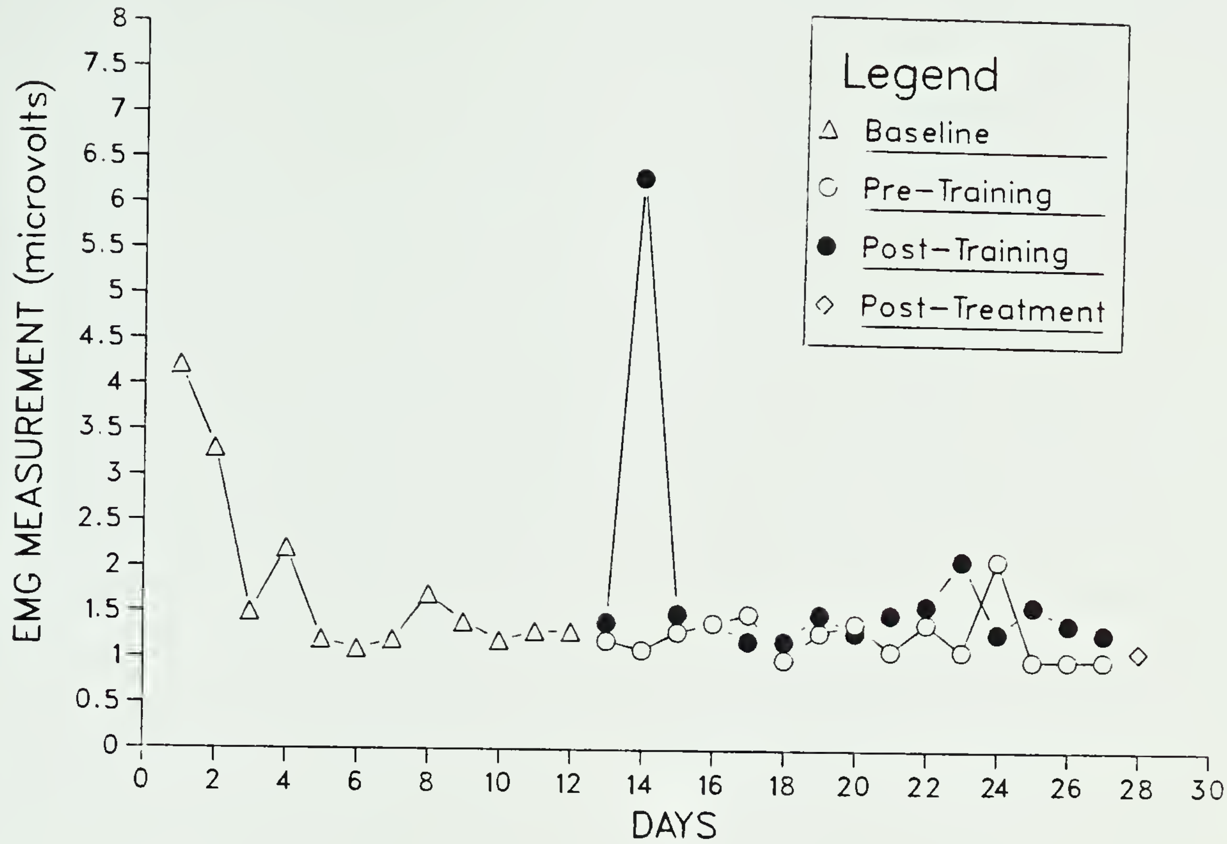

Figure 13. Daily EMG Means: Subject 5

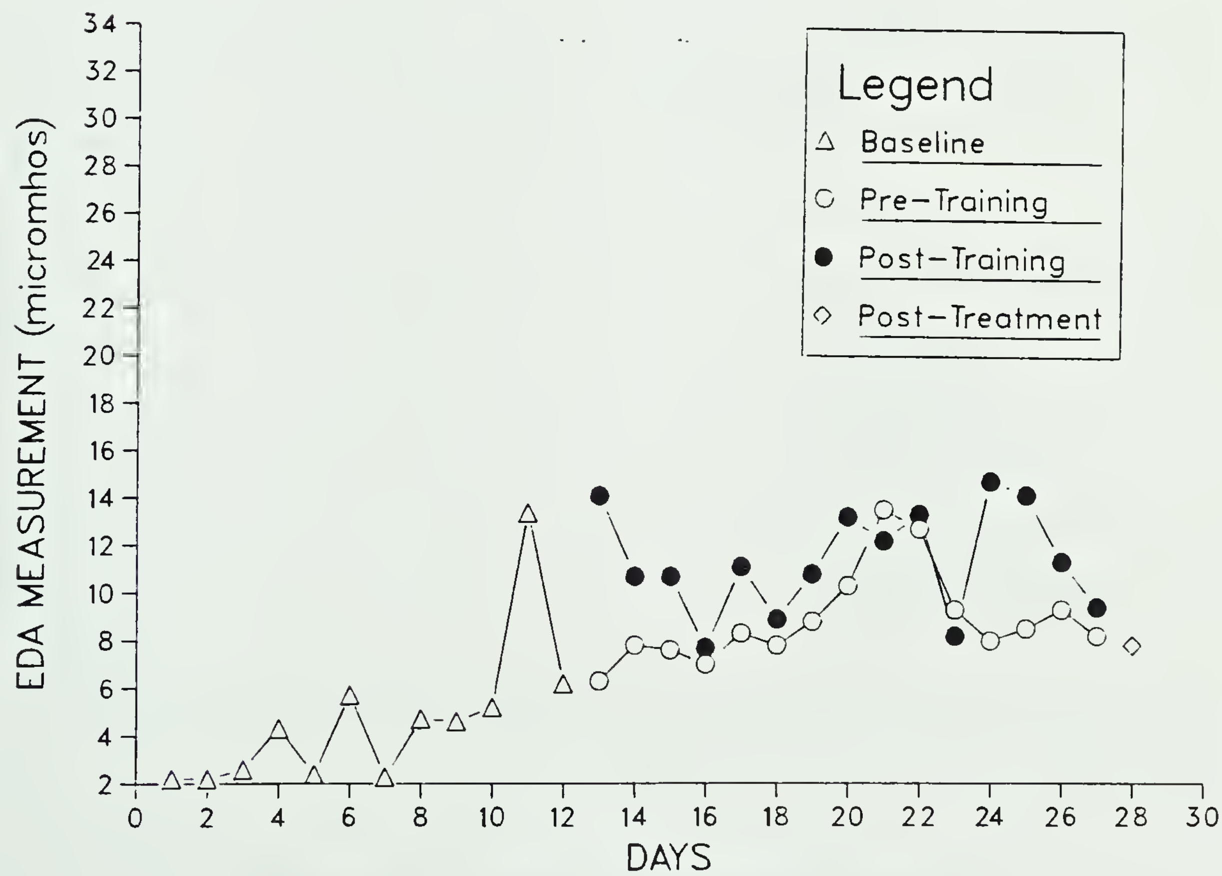

Figure 14. Daily EDA Means: Subject 5

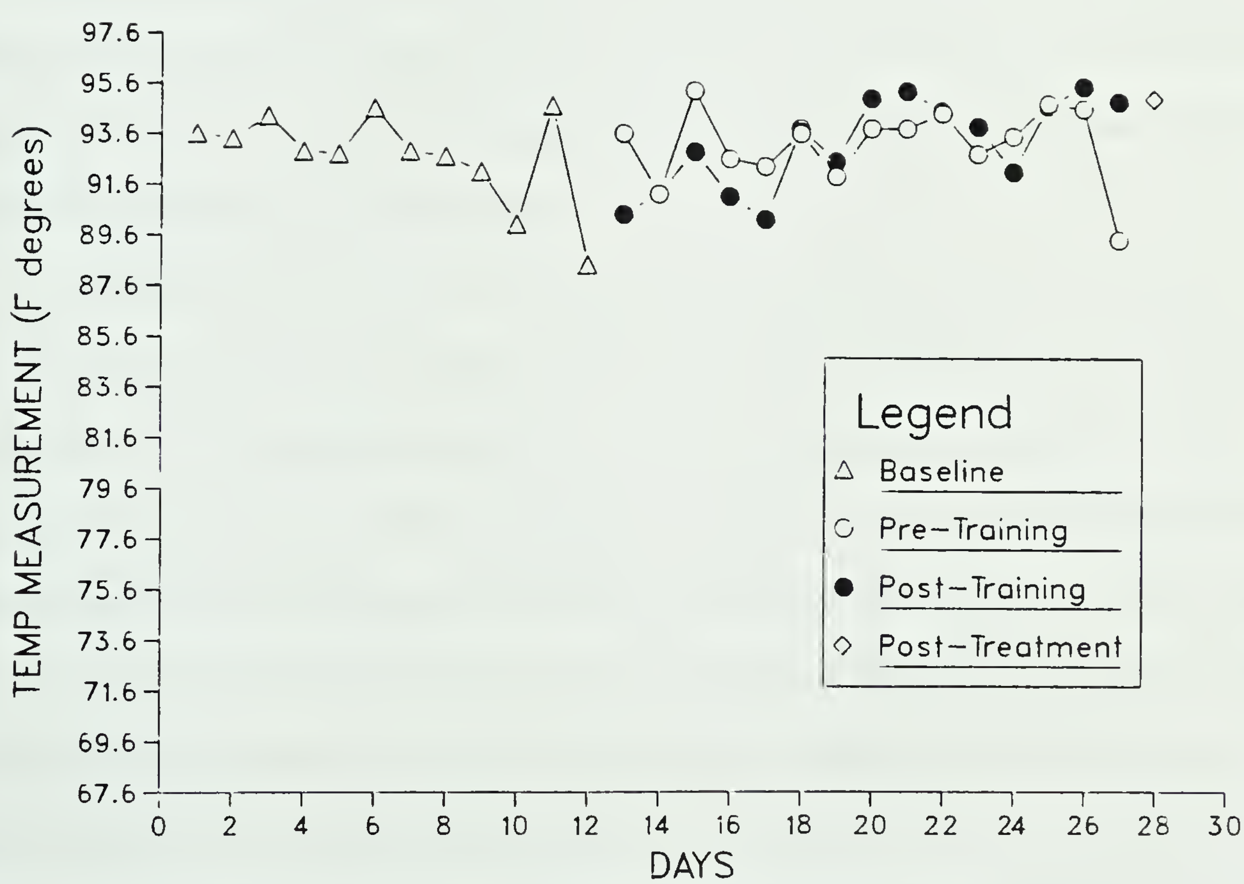

Figure 15. Daily TEMP Means: Subject 5

pre-training/post-training increases and decreases. These data exhibited a negative slope during baseline, which changed to a positive slope during pre-training. The results suggest that there was possibly a relaxation effect from the treatment on Subject 5. However, the effect occurred on the first day of treatment. Most of the other subjects have needed time after the onset of treatment to become accustomed to the treatment. Either Subject 5 did not need time to adjust, or else some factor other than the treatment influenced these data.

(2) The pre-training/post-training EMG differences for Subject 5 showed only four means that decreased (Table 3). Table 14 shows that three of these were on the last day of Tapes 1, 2, and 3 (Days 16, 20, and 24). This may indicate the amount of time necessary for Subject 5 to become familiar with the taped instructions. During the post-training session on Day 14, the subject was uncomfortable due to an itch but did not want to move for fear of upsetting the measurements. Figure 14 shows this uncharacteristic data point which was removed from the post-training data for analysis.

The same trend as that of the EMG measurements was evident in the EDA data. Table 6 shows the increased overall means and that the majority of pre-training/post-training means increased for Subject 5. The data in Figure 14 clearly shows the post-training means higher than the corresponding pre-training means.

The TEMP data showed no clear effect of the treatment (Figure 15). The overall post-training mean was lower than that of the pre-training means (Table 6). Six of the fifteen pre-training/post-training differences showed a decreased mean level, indicating that the treatment was not effecting a relaxation response in Subject 5. Table 14 shows that four of these decreases occurred within the first five days of laboratory testing (Days 13, 15, 16, and 17). Subject 5 may have needed this time as an adjustment period to the treatment. Decreased post-training means were also evident on Days 24 and 25. Although the decrease was very slight on Day 25 (-0.12 degrees), there were similar responses shown in an increased EMG mean and a large increase in EDA on this day. A high pre-training EMG mean on Day 25 and a large increase in electrodermal activity accompanied the decrease in TEMP during this

session. These data represent an increased stress response and strengthen the contention that the treatment was not an effective inducer of the relaxation response in Subject 5.

(3) A further examination of the interrelationship among the physiological variables in Table 8 shows that there was virtually no relationship between any of the pairs of physiological variables for this subject.

(4) The relationship between the physiological data and the self-report data shown in Table 10 also revealed no treatment effect for Subject 5. Only four of the thirteen pairs of EMG and RUS difference scores supported a positive correlation. These four cases (Days 15, 20, 21, and 24) reflected no pattern to explain them. There was inconsistency noted in the RUS ratings for Subject 5 throughout the study and even within the sessions of each tape.

Non-supportive results were also found in the relationship of EDA to RUS. Only three of the total fourteen pairs of scores showed the expected positive correlation. Two of these were at the beginning of the treatment phase during Tape 1 (Days 15 and 16), indicating that the subject was not basing her self-reported stress on her electrodermal response. There were no trends in the data that would lead to an explanation of these results.

Examining TEMP and RUS difference scores for Subject 5, the expected negative correlation was evident in only seven of the fourteen sessions (Table 10). In addition, during two of the sessions in which stress level was reported as unchanged (Days 14 and 22), the physiological measurement also remained constant showing only a minimal change of +0.03 degrees and +0.02 degrees, respectively. The sessions showing an unexpected relationship between TEMP and RUS were on Days 13 and 18, when there was no reported change in stress level, yet there were large decreases in TEMP. The decrease in TEMP may have reflected the uncertainty of the subject experiencing the treatment for the very first time on Tape 1 and Tape 2. There was a discrepancy between direction of the TEMP change and that of the self-reported stress level on the first day of each new tape (Days 13, 17, 21, and 25). However, these differences were not directionally consistent. On Days 13 and 17, a decrease in TEMP was accompanied by no reported change in stress level. On Day 21, an increase in stress

level was reported while an increase in TEMP was recorded. A decrease in stress level and a decrease in TEMP was shown on Day 25.

Summary

The data for Subject 5 was inconsistent within and across variables. The only statistically significant result that occurred for Subject 5 was an increase in TEMP level from baseline to treatment. The subject reported in the post-research questionnaire that "the {relaxation} training did not help me any...during most of the tapes I felt more tense afterwards than I did before I started". The physiological data in several instances confirms these comments. The EMG and EDA data showed that the majority of post-training data points were greater than the pre-training data on the same day. Without any use for the treatment or willingness to try to apply it, the treatment sessions were probably considered by Subject 5 to be a waste of thirty minutes. Describing herself as a "hyper" person, she was observed as being restless during some of the treatment sessions. The trend of the EDA data revealed this increased activity level during post-training.

Even though Table 2 shows a decreased overall mean for the EMG measurements during post-training, the graphed data shows that the baseline means plateaued at Day 5 and remained at that level. None of the other data of any of the physiological variables showed any probable signs of a treatment effect.

Subject 6

The EMG data for Subject 6[15] was extremely variable throughout the thirty days (Figure 16). Table 2 shows that there was an increase in mean level from baseline to pre-training with a return to baseline level during the post-treatment phase. The statistical analysis revealed this level change to be insignificant. A significant decrease in slope of EMG

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[15] The reader is reminded that Subjects 6, 7, and 8 did not receive treatment. The data, however, for these subjects was separated into the three phases (baseline, pre-training, and post-treatment) for comparison of these results to those of Subjects 1-5 who did receive treatment. Only the first of the four analyses could be done because the modified-experimental subjects did not receive treatment.

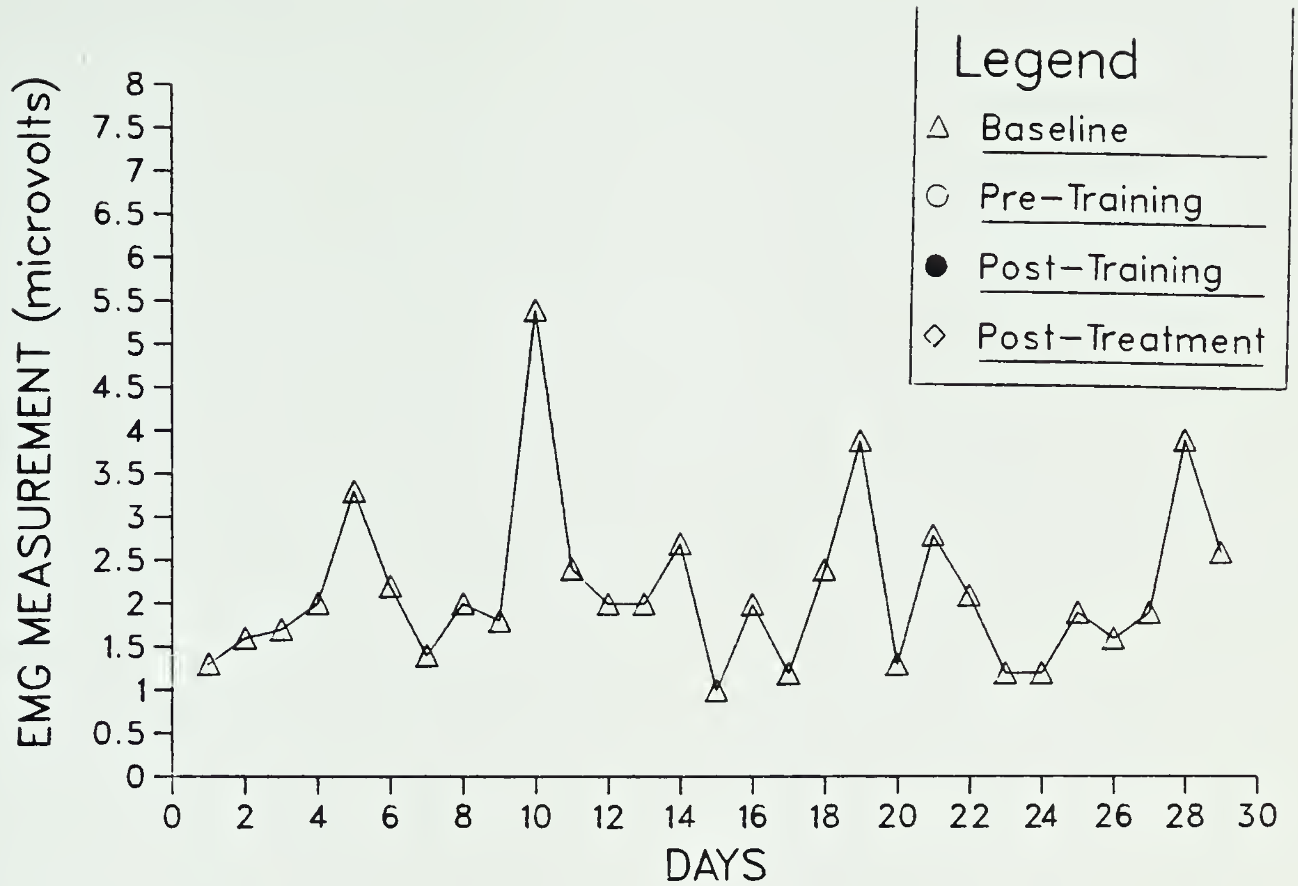

Figure 16. Daily EMG Means: Subject 6

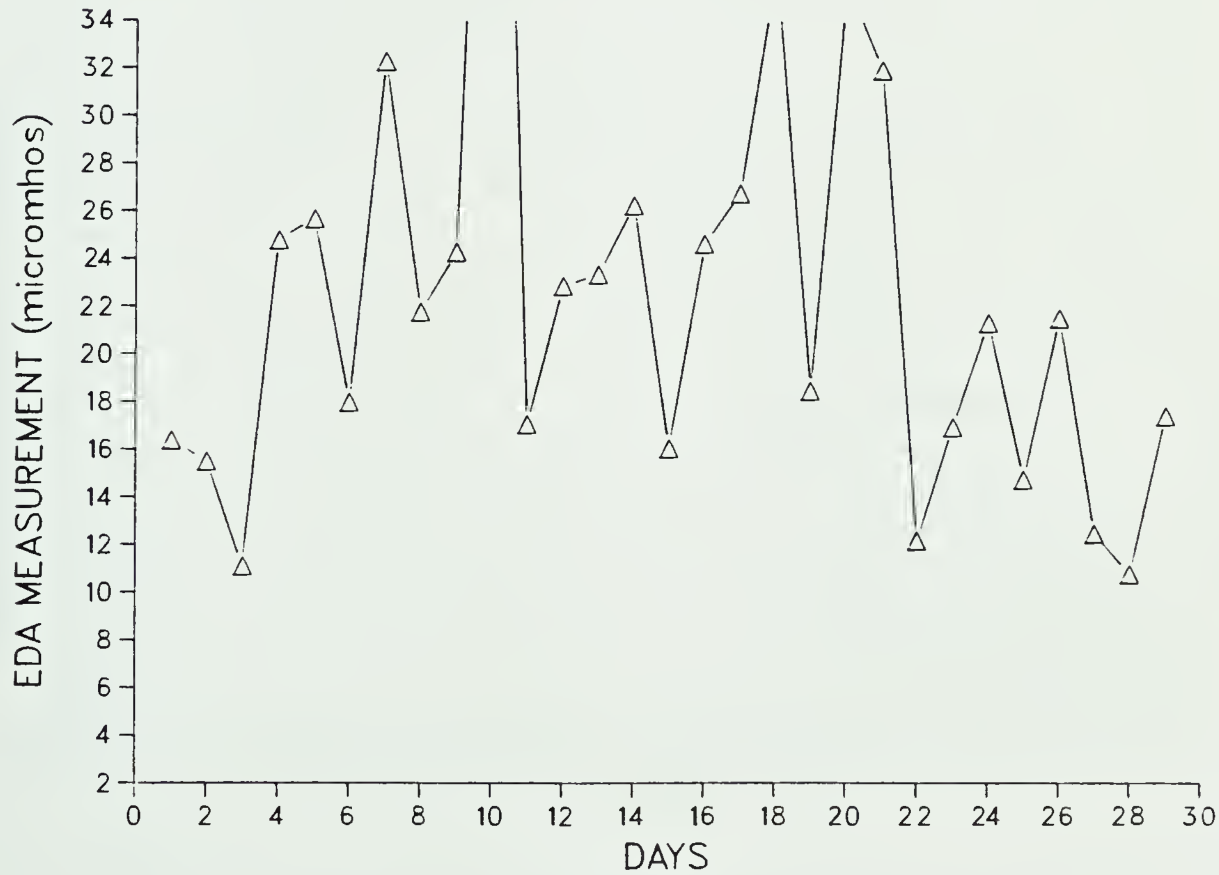

Figure 17. Daily EDA Means: Subject 6

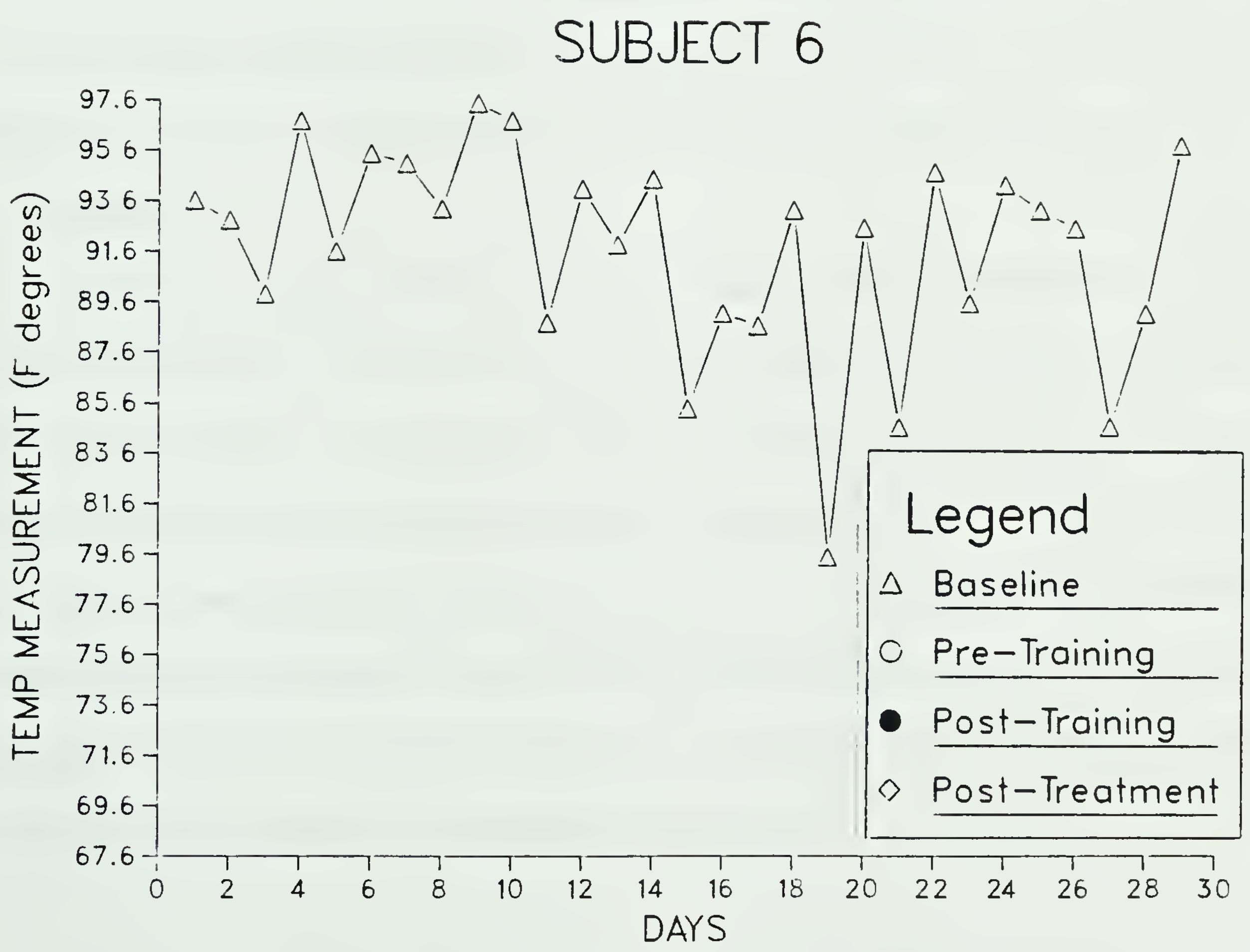

Figure 18. **Daily TEMP Means: Subject 6**

data was found for Subject 6. This merely indicated the tension level to plateau at a higher level than it began in baseline. The variability throughout the data, as well as the high points on Days 10, 19, and 28, may have influenced the analysis by reducing the consistency of any trend in the data. These three high points were all days when Subject 6 had just taken an exam. In addition to seeing no decrease in mean level across time, the majority of the pre-training means (11) were above the level of the baseline mean (Table 2).

There was extreme variability in the EDA data throughout the study (Figure 17). Twelve out of the sixteen pre-training means were greater than the overall baseline mean (18.57 mhos) or median (17.20 mhos). Observational data was not available to justify the three peaks of the EDA measurements on Days 10, 18, and 20. The three EMG peaks were not consistently matched by the EDA data. Only on Day 10 were there high EMG and EDA measurements. The high EMG means on Days 19 and 28 were accompanied by low EDA scores, showing little interrelationship between these two physiological variables.

No treatment effect was found for the highly variable TEMP measurements for Subject 6. Ten of the sixteen pre-training TEMP means were below the baseline mean level.

Summary

A significant change in slope, reflecting a plateau at a high level of EMG, was the only statistical evidence found for Subject 6. There were no data from any of the physiological variables for this subject that reflected the relaxation response during the pre-training phase. The high variability on all the physiological variables as seen in the data of Subject 6, was not seen across all of the experimental subjects (Subjects 1-5). The only cases of high variability were the TEMP data of Subjects 2 and 4, which exhibited moderate variability relative to all eight subjects. Subjects 2 and 4 did, however, show a treatment effect with data from another physiological variable, which was not the case with Subject 6.

Subject 7

In support of the stress response, a significant level increase in EMG was found for Subject 7. Examining the variable data (Figure 19), the baseline data (Days 2-6) may be representative of one of the stable periods in between the high peaks. With the exception of Day 17, the EMG high points (Days 1, 7, 13, 17, and 23) did not coincide with the EDA data or TEMP data for this subject, nor was there observational data to justify these outstanding responses. The observational data did reveal that on Day 17, the subject had several school assignments due, which were not yet completed at the time of the testing session. The increased EMG and decreased TEMP response on this day were possibly influenced by the stressfulness of this situation. High points of the EMG data during pre-training measurements were seen only by Subjects 6 and 7, suggesting that the treatment may have had the effect of decreasing the instances of large increases of muscle tension.

There was an equal number of pre-training EDA means below and above the baseline mean level. The data in Figure 20 shows that even though the level may have decreased[16], the means for Days 18-22 were above all the previous pre-training means, showing a consistent increased level of electrodermal activity toward the end of the pre-training phase. Personal notes indicated this period of time a very busy one at school for this subject. She had mid-term exams and assignments due, which were perhaps causing a stress response of increased electrodermal activity to occur. Although the post-treatment means seemed to level off, the plateaued level was above that of the baseline phase. The only resemblance of such a trend in the experimental subjects was in the data for Subjects 1 and 4, who showed an increase of EDA toward the end of the pre-training phase. These data, however, did not show the increase over a five day period as did Subject 7.

The cyclic and extremely variable TEMP data for Subject 7 did reveal a significant increase in level. The TEMP means for Subject 7 calculated in Table 2 are not representative due to the extreme variability of the data. A heavy schedule at school, highlighted by exams

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[16] The mean level of the pre-training phase increased when the aberrant data points were not omitted from the analysis in Table 2.

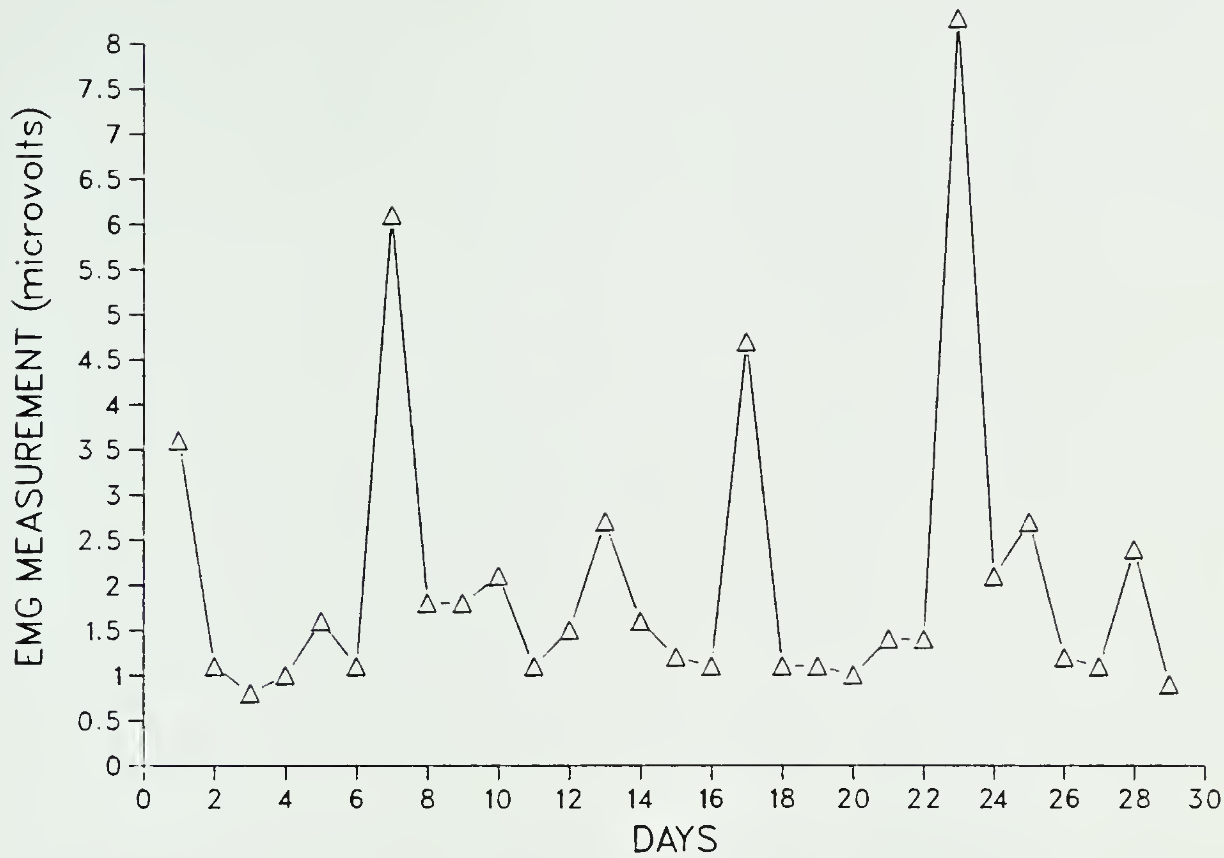

Figure 19. Daily EMG Means: Subject 7

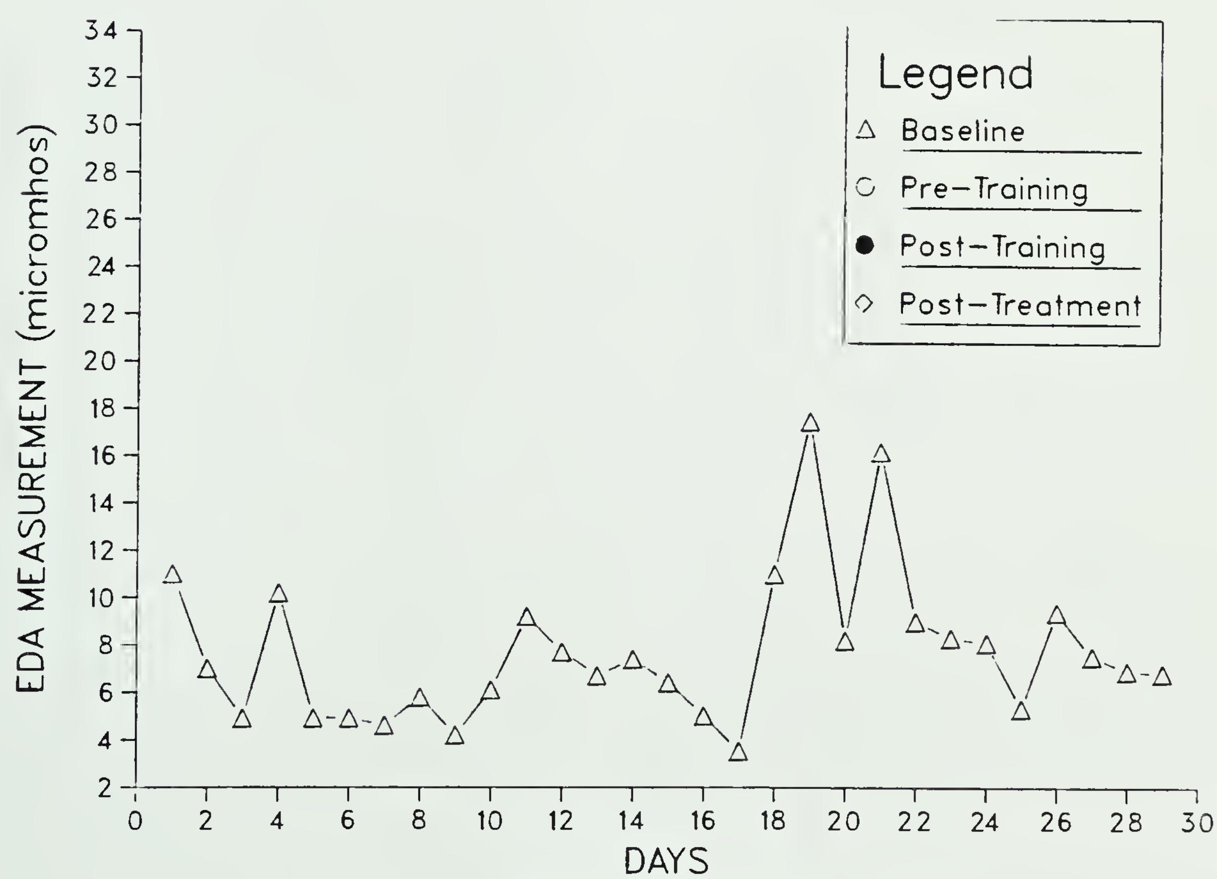

Figure 20. Daily EDA Means: Subject 7

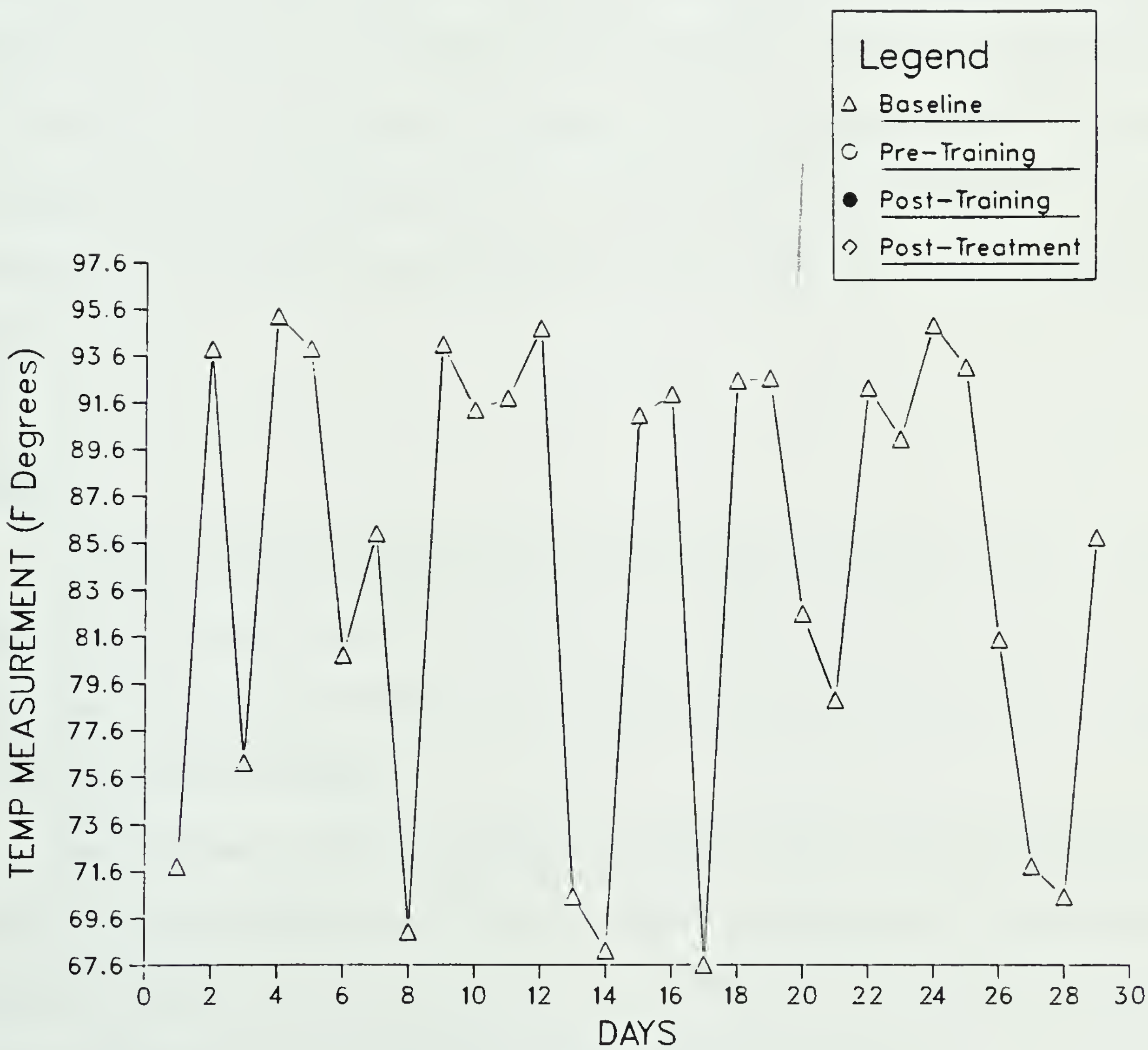

Figure 21. Daily TEMP Means: Subject 7

seemed to coincide with the low points of the TEMP data, exhibiting the stress response. Exams were to be taken later in the day on Days 13, 14, and 17. Final exams were scheduled on Days 24-28. The data pattern of TEMP for these days, seems to indicated that the situational stress gradually built up in this individual during the final exam period, resulting in a gradual decrease in peripheral temperature over this period of time.

Summary

The EMG and TEMP data for Subject 7 showed the opposite of the relaxation response. Increased muscle tension level and decreased temperature were accompanied on both accounts by increased variability of the measurements within the pre-training phase. The EDA data did show a decrease in mean and variability during the pre-training phase. This may have been due to the placebo effect of being a part of a research study. Merely having physiological measurements monitored may have been considered "treatment" to Subject 7. She reported that "the laboratory sessions were great relaxation...{that} it was a nice break during the school day because it made you sit down and relax". The data for this subject during Days 18-22 showed that when the stress of school pressures compounded, she did not have the ability to control it.

Subject 8

A significant level and slope change that represents the "relaxation response" was found in the EMG data of Subject 8. This refutes the hypothesized expectations of the treatment on the experimental subjects, since Subject 8 was a modified-experimental subject who did not receive the treatment.

The EDA means, however, increased across phases, and all of the pre-training means were above the mean baseline level (7.79 mhos) (Table 2). Although there was no statistical significance found in these data, the slope did show a constant trend upwards. This suggests similar characteristics to that of Subject 1 who did receive the treatment.

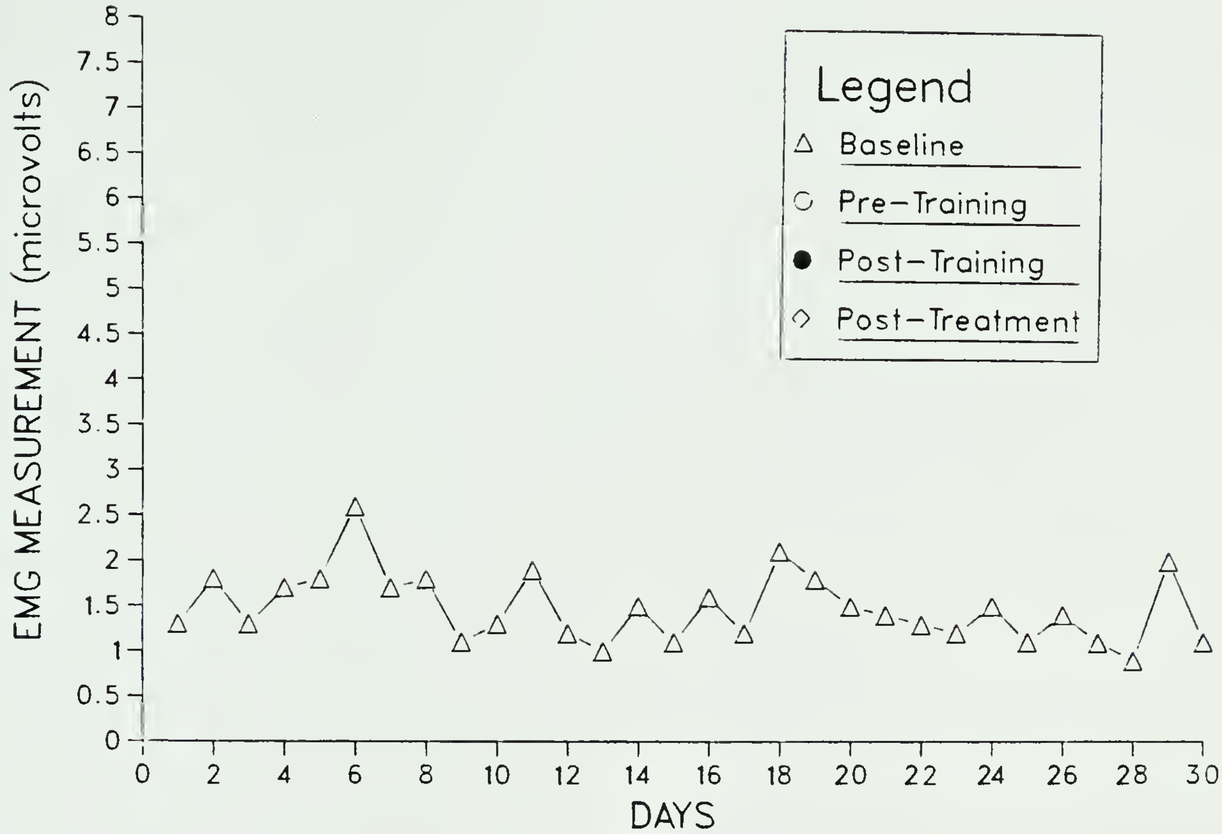

Figure 22. Daily EMG Means: Subject 8

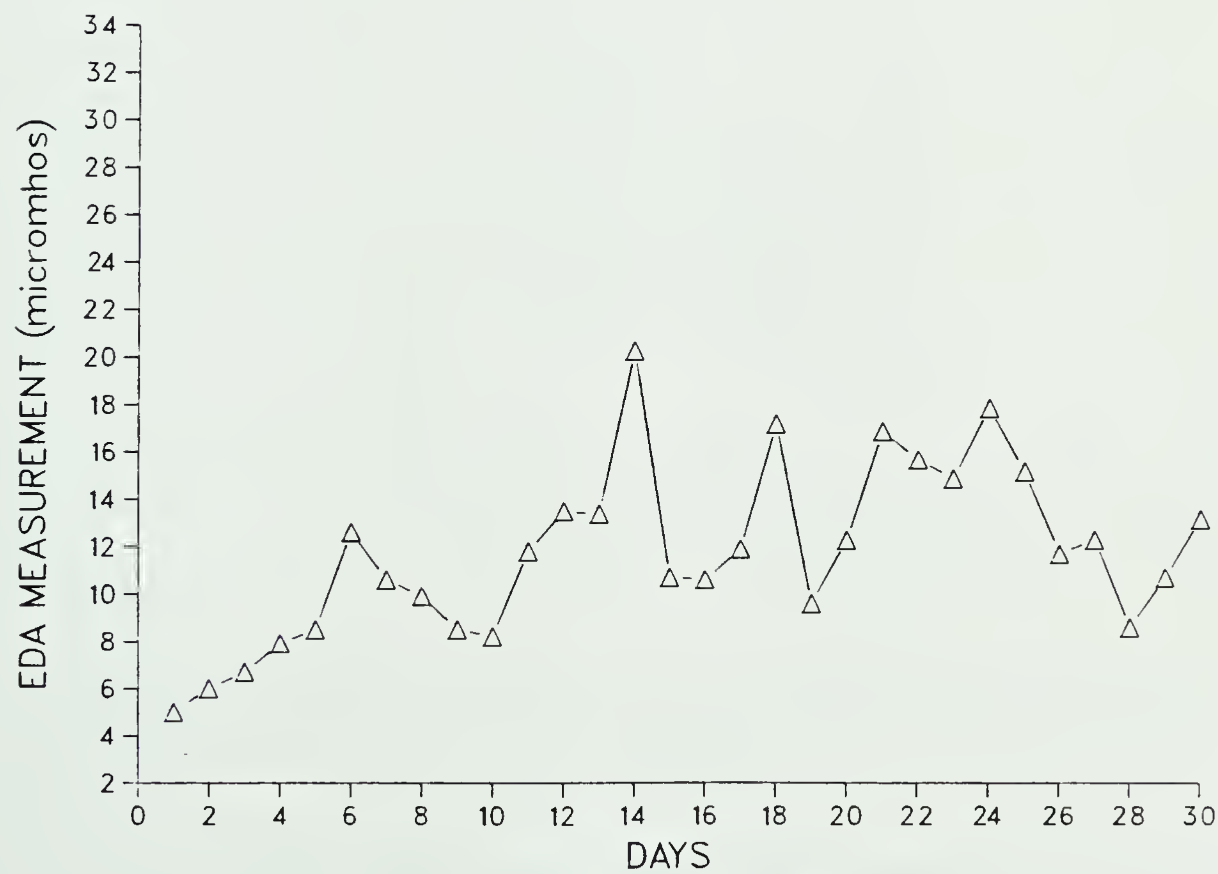

Figure 23. Daily EDA Means: Subject 8

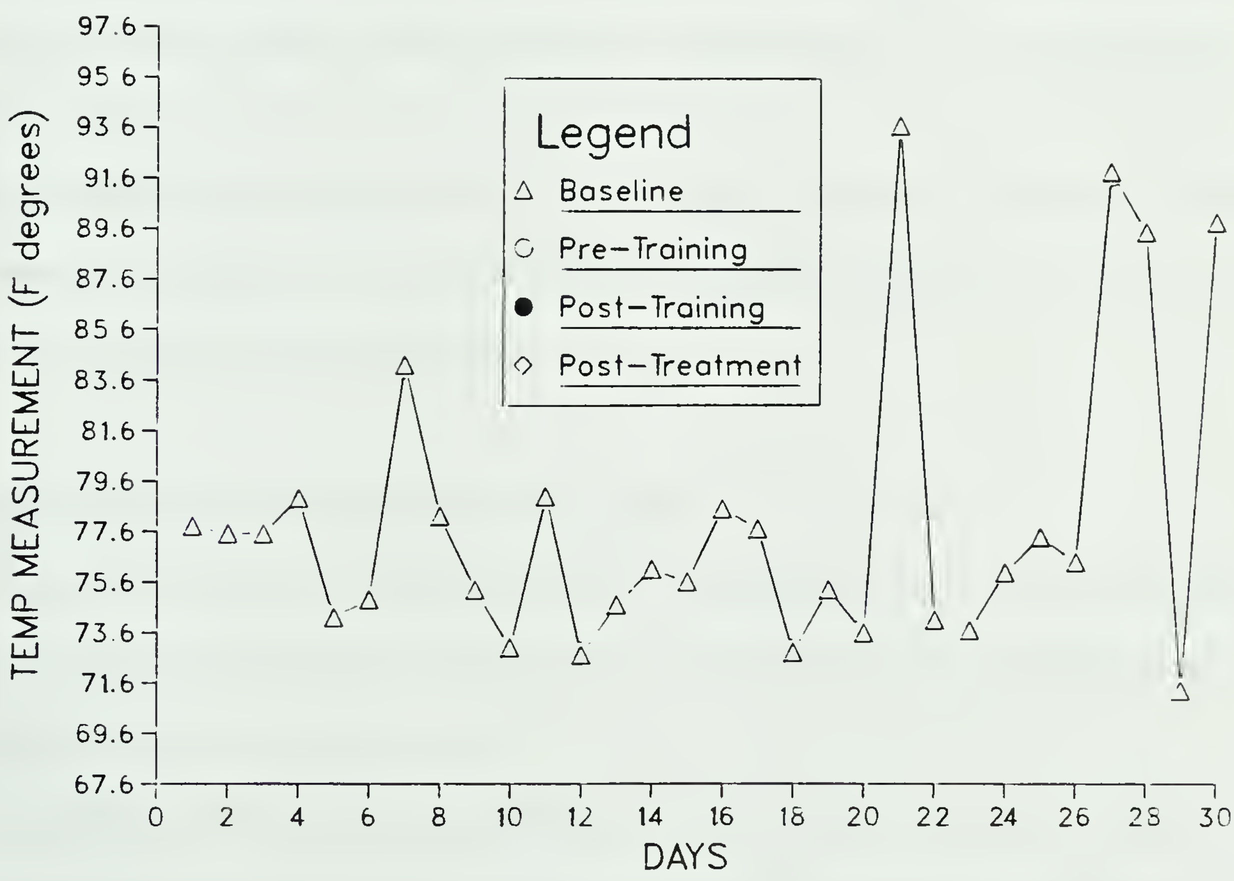

Figure 24. Daily TEMP Means: Subject 8

The majority of Subject 8's TEMP data was at a rather low level. Statistically, a significant level change was noted. Figure 24 shows a substantial increase in variability in TEMP data during the pre-training phase with both increases and decreases in TEMP beyond the range of the baseline measurements. This inconsistency was unaccounted for.

There was no observational data to explain the peaks in the physiological data of this subject. It appears, however, that Subject 8 consciously or unconsciously was able to control her trapezius muscle tension. The other physiological results suggest that this control did not carry over to her EDA and TEMP responses.

Summary

Subject 8 showed decreased muscle tension across phases both in mean level and in degree of decrease (slope). This indication of the relaxation response was very similar to that of Subject 3. The fact that Subject 8 did not receive treatment may have been due to some extent to the placebo effect of merely having her physiological responses recorded. Subject 8 seems to already have had some skills in controlling her level of tension, even though she has never had any formal training to develop this skill. She was able to come into the laboratory "most of the time...{and} just sit, relax, and go into oblivion". The combination of placebo and her own skills may have accounted for the relaxation response noted in the data. Her EDA and TEMP data responded in the opposite direction, with increased EDA and decreased TEMP marked by a moderate level of variability.

D. Integrated Summary of Physiological Data Analysis

To further explore the expected findings of the treatment effect on the experimental subjects, the data for Subjects 6, 7, and 8, who did not receive treatment were compared to that of Subjects 1-5.

Subjects 6 and 7 showed similar EMG physiological patterns, opposite to those of Subjects 1-5 and 8, and to that of the "relaxation response". Although Subject 6 had the highest baseline EMG mean of any of the eight subjects, it was a mean level of 1.99 Mvolts,

which is still considered a rather low level of muscle tension according to clinical studies. Subjects 6 and 7 had the highest variabilities across all three phases and the highest means of the pre-training and post-treatment phases. The data for these two subjects were the only data that showed the majority of pre-training EMG means (11 out of the total 16) above the level of the baseline mean. Statistically, however, Subjects 2, 3, and 8 were the only ones to show a treatment effect, evidenced by a decrease in level between baseline and treatment phases.

These descriptive statistics of the EMG data lack support for the treatment effects. Subjects 6 and 7, who received no unstressing treatment and exhibited extremely variable responses different from those of the subjects who did receive treatment. This suggests support for the notion that the modified progressive relaxation treatment used in this study may have reduced variability in trapezius muscle tension. Although "control" Subject 8 responded in a way similar to the treatment group, the combination of a placebo effect and her own level of stress control not apparent in the other subjects, may have contributed to the "treatment effect" evident in her data.

The EDA variable did not show such a discrepancy between the experimental and modified-experimental subjects. These data did not show any tendencies toward decreased means across time for any subjects. Subjects 1-4 and 7 tended to stay close to the level of their baseline mean during the pre-training and post-treatment phases. Subjects 5, 6, and 8 however, showed substantial increases in their mean pre-training levels. Although Subject 7 did not show much change between baseline and pre-training means, the trend of her pre-training and post-treatment data showed a rapid increase on Day 18 that remained at a higher level.

Subject 6 did show an extreme amount of variability and a very high mean level in her EDA measurements. She had very little time during her busy school schedule for the laboratory sessions. There never was more than a half hour block of time free during the day. Thus, when she came to the laboratory sessions, she "used {them} to think about what I had to do that day". These factors may have been influential in the cyclic data with high peaks and

the high variability of her EDA measurements.

The TEMP data also did not provide clear evidence vis a vis a treatment effect. Subjects 1, 3, and 5 had fairly consistent measurements throughout the study. There was high variability seen in Subjects 2 and 7. When comparing the data from Subject 2, who received treatment, and Subject 7, who received no treatment, there is no evidence that the unstressing treatment provided the subject increased control over her level of peripheral temperature.

Of the three physiological variables, the modified progressive relaxation seemed to be most influential in effecting a reduction in trapezius muscle tension. Subjects 1 and 5 showed that it is not necessary to observe reduction in muscle tension directly after the treatment (post-training data). Rather than listen to the taped instructions, these subjects may have preferred to incorporate the unstressing technique into their own method, which was more beneficial to them. The treatment was not the only factor in the reduction of muscle tension, as these subjects showed a decrease in their muscle tension prior to treatment in the pre-training phase.

The other experimental subjects (Subjects 2, 3, and 4) showed obvious decreases in trapezius muscle tension immediately after the relaxation training. For Subject 3, both an immediate and a long-term reduction in trapezius muscle tension was observed. Her data also showed that psychological awareness of her stress level and her level of muscle tension had a somewhat strong relationship. On the other hand, Subject 1 seemed to psychologically and physiologically be responsive to her electrodermal activity as a sign of increased or decreased stress. Subject 4 showed strong support of a change in peripheral temperature due to the unstressing treatment. She also was psychologically attuned to this variable in her self-reported stress level.

These findings emphasize the importance of individual response styles, as advocated by Lacey et al (1958). The initial levels of responses were different for each subject and showed changes in varying intensities and directions. The highly individualistic data patterns of Subjects 6 and 7 raise several questions about what responses would have resulted had they

been subjected to the treatment. With such variability in the data of Subject 6 across all three physiological variables, would the treatment have allowed her to be in control of these responses? For Subject 7, would the unstressing treatment have affected the cyclical spikes of the EMG data, the consistent increased level of the EDA data at the end of the pre-treatment phase, and the extremely low mean values of the TEMP data?

V. RESULTS OF PERFORMANCE DATA ANALYSIS

The second purpose of this study was to determine the extent to which the unstressing training affected the subject's cognitive appraisal of the gymnastic skills as well as her performance on these skills.

In this study, there was an indirect link between the unstressing treatment and the subject's performance of gymnastic skills. The treatment was administered in the laboratory, twice a week for each subject. The performance testing was also done twice a week. In some cases, the subjects may have had a laboratory session in the morning and a performance session in the afternoon on the same day. In most cases, the laboratory and performance sessions were completed on different days of the week.

A. Introduction

There was a strong effort made to keep the modified-experimental subjects from knowing that the other subjects were receiving an unstressing treatment while in the laboratory. Post-research personal interviews revealed that the modified-experimental subjects were, in fact, naive to any treatment procedures that were used with the experimental subjects.

The training or 'cue words' used in the treatment were never mentioned during the performance sessions. Tape 4 was the only tape that did specifically refer to one of the performance skills (Skill C). Thus, the only other connection existing between unstressing training and performance sessions was each subject's attempt to apply the technique in the performance sessions. In light of this, the discussion of the performance data analysis permits only speculation regarding any relationships that are found. Possible treatment effects are discussed, but no conclusions have been drawn due to the potential interaction of extraneous factors.

To determine the subject's perceived level of stress for each of the gymnastic skills, data from Part C of SARP was used. The possible ranges of the stress ratings[17] were as

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[17] Skills C and H each had six skill progressions. Therefore, the possible range of the stress ratings for these two skills was 6 - 60.

follows:

	Range
Total Score on SARP	52-520
Stress Ratings of each Skill	5-50
Stress Ratings of each Progression within a Skill	0-9

The definition of stress used in SARP, "emotional feelings of nervousness or tensesness", may have been perceived as a consequence of frustration and/or fear. The data for each subject was used to discuss these different interpretations of *stress*.

The performance skills were matched across the two gymnastic events to determine whether there was any transfer from a skill on one event to the same or very similar skill on the other event. The other reason for matching the skills was to observe a better cross-section of skills from the subjects. If skills only on one event had been used, data may have been biased toward subjects who were of a higher skill level on that event. Throughout the performance analysis, the results were grouped in their matched pairs (Skills A and F, B and G, C and H, D and I, E and J).

The performance data were separated into four parts: baseline, $treatment_1$, $treatment_2$, and post-treatment. The baseline and post-treatment phases coincided with the similar phases of the physiological testing. For the performance analysis, the treatment phase was separated into two parts. $Treatment_1$ included data from the first six days of performance testing. The remaining ten days of the treatment phase were referred to as $treatment_2$. The researcher chose this delineation for several reasons. It was assumed there would be a period of time between the first physiological treatment session and the subject's opportunity and ability to apply the training within the performance testing setting. As the second, third and fourth tapes were merely extensions of the basic technique learned in the first tape, it was hoped that this partitioning of the treatment phase would better exemplify the link between the treatment and its effect on performance. The seventh testing day was chosen as the beginning of *$treatment_2$*, because the subject would have already completed the first tape of the unstressing treatment

and be half way through the second tape.

Within these parameters, the analysis of the performance data was done specifically to examine any significant changes occurring between the first six days ($treatment_1$) and the remaining ten days of the treatment phase ($treatment_2$). The slope and range of scores as well as the level of change between phases were calculated to determine if the rate of performance change increased or decreased, if the variability of performance differed, and whether or not there was a difference in level of performance. The robust slope was calculated from three median scores[18]. The range and level for each skill were also calculated using the median scores.

B. Performance Analysis for Individual Subjects

The organizational format of Chapter V is composed of the following areas of analysis. The data for each subject will be individually discussed according to her stress perception of the skills (SARP), as well as her performance trends over time on each skill. The analyses will be drawn together into an integration of the findings for all subjects. The final section draws upon data from the Post-Research Questionnaire to further integrate the data.

There were three stages of analysis used to evaluate the performance data. First, the ten skills for each subject were individually analyzed by examining the trend in data throughout all the stages in the study, but particularly between the baseline and the two treatment phases ($treatment_1$ and $treatment_2$).

The second stage consisted of a comparison of the data analysis between the high-stress skill and the low-stress skill[19] for each subject. The unstressing treatment was hypothesized to have a greater effect on high-stress skills than on low-stress skills. The results of performance of the high-stress skills may show performance variations in addition to the effects of stress on performance. Whereas, the low-stress skills may be more representative of merely the

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[18] One median was calculated for each of the three sets of five repetitions of each skill. The medians for all days within each treatment phase were used to calculate the robust slope.

[19] The high-stress and low-stress skills were designated according to each subject's response on Part C of SARP. The skills were therefore different for each individual.

performance variation factor evident during practice of all skills. If this assumption holds true, performance on the low-stress skills will not show the interference of the stress factor to the same extent as with the high-stress skills. Thus, by comparing data trends in high-stress and low-stress skills, variations may be partially understood in terms of the effects of stress on performance, and improvement differences attributed to unstressing skills vis a vis practice effects.

The third stage of analysis compared the performance analyses of the experimental subjects to those of the modified-experimental subjects to determine if there was evidence of the effect of the unstressing treatment on performance.

The format of this part of Chapter IV is the same as that of the physiological data analysis. The data for each subject will be individually discussed according to her stress perception of the skills (SARP), as well as her performance trends over time on each skill. The analyses will be drawn together into an integration of the findings for all subjects. The final part of the chapter will include the synthesis of the physiological and performance data for all subjects.

Subject 1

The SARP score for Subject 1 showed a decrease from 164 to 146 (Figure 25). The individual stress ratings for each skill showed an increase on five of the ten skills, four of which were uneven bar skills (A, B, C, and E) (Table 15, #2). Skill I showed a substantial decrease, which accounted for most of the difference in stress ratings between the pre- and post-test. Subject 1 remained on the first progression of Skills E and J throughout the study. It appears that the increase in stress ratings on these skills was more of a feeling of frustration than fear.

To determine whether the mere exposure to the progression reduced the perceived stress, the total stress ratings of only the skill progressions performed during this study were calculated (Table 15, #3). Only one skill (B) showed a slight increase on the low end of the

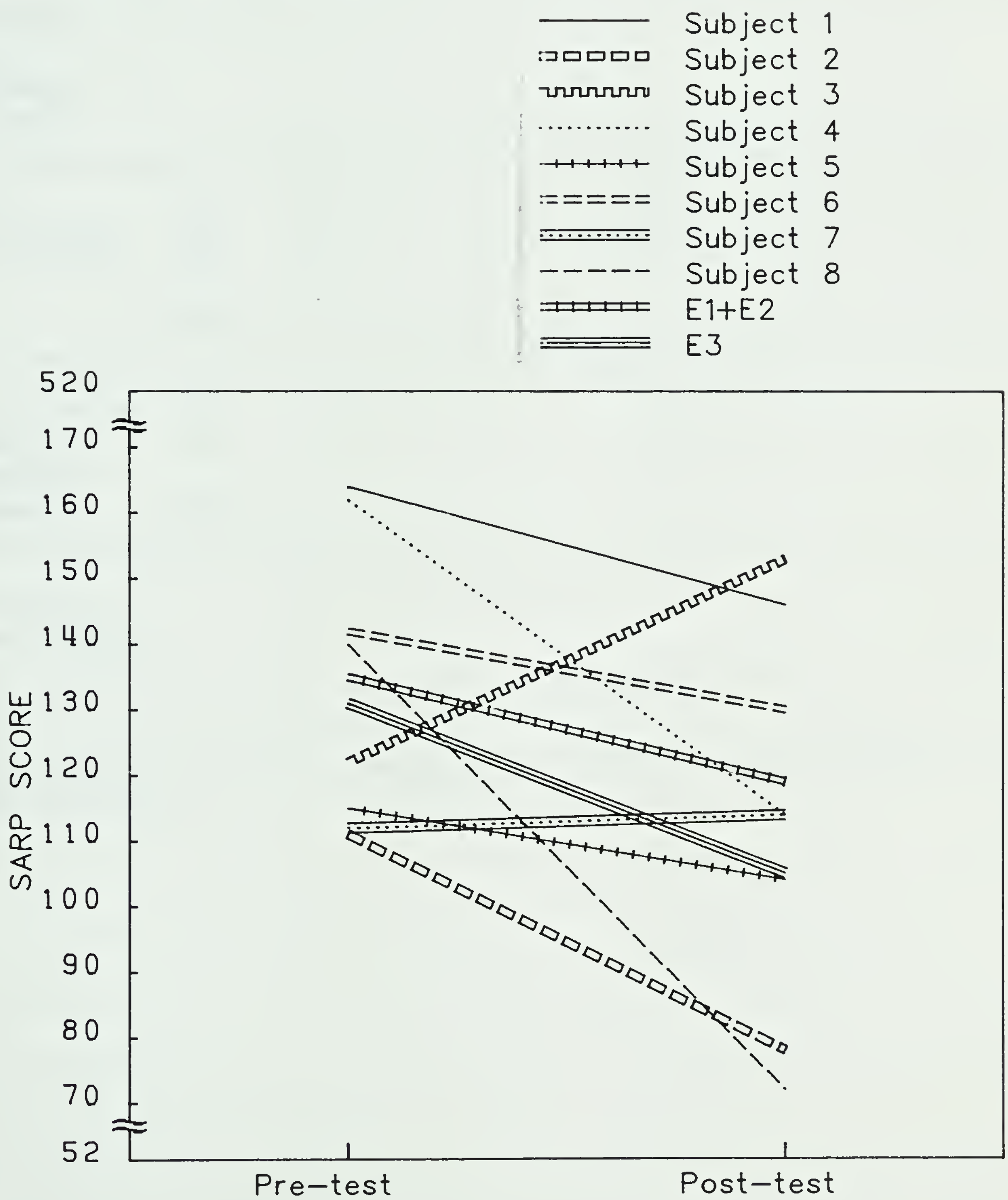

Figure 25. Pre-Test Post-Test Scores on SARP

Table 15
Stress Ratings of Skill Progressions
Subject 1

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		2	2	2	2	3	3	2	3	1	1	
2. Total Stress Ratings	Pre	23	12	8	19	18	22	14	20	12	16	164
	Post	27	7	10	14	19	16	12	9	13	19	146
	Change	+4	-5	+2	-5	+1	-6	-2	-11	+1	+3	
3. Total Stress Ratings of Progressions Performed	Pre	7	2	0	5	5	9	0	8	0	1	37
	Post	6	0	1	1	1	2	0	0	0	0	11
	Change	-1	-2	+1	-4	-4	-7	0	-8	0	-1	
4. Pre-Test Stress Rankings		7	4	4	6	6	5	3	6	5	4	50

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

stress scale. All other stress ratings decreased or remained at "0" stress level, indicating that after executing the skill a number of times, Subject 1 perceived it to be less stressful. These data did not provide evidence of any difference in the intensities of changes in stress level between the high-stress and low-stress skills. However, all the skills with high stress pre-test ratings (Table 15, #4) did show decreases when using only the progressions Subject 1 had performed during the study (Table 15, #3).

Performance Skills

Of the six skills that indicated positive slope changes, those of Skills H, J, and C were the largest (Table 16). Skill H showed an increase in variability during treatment_2. The peaks of the treatment_2 data points were higher than those during treatment_1 (Figure 26). One data point dropped to a low point at the beginning of treatment_2, after which a steady performance improvement contributed to an increased slope and achievement of the criterion level for change to the next skill progression. The level change was slight (5.3 to 5.9) indicating a less prominent performance increase.

The slope of Skill J changed from a negative to a positive value between the treatment phases. The increased range by one score on the upper end of the scale and the prominent level change between treatment phases (+1.1) suggests an improvement in performance. However, the graphed data on Figure 27 show that this change did not occur until Day 15. This may have been due to a delayed effect of the treatment on performance or merely a practice effect.

High-stress Skill A showed a very slight performance improvement between treatment_1 and treatment_2. The slope increased from -.04 to .00, the level increased from 6.9 to 7.1, and the range decreased from 3 to 2. This skill was close to the criterion level, and therefore had little room to show improved performance scores.

Skill G, also rated as a high-stress skill by Subject 1, showed a substantial increase in slope influenced by the low scores at the beginning of treatment_2. The level change between phases did show an increase from 3.3 to 3.9. These changes did not occur until Day 17, five testing days after the beginning of treatment_2. Thus, unless the time needed from application

Table 16
Slopes, Ranges, and Levels of Performance Data
Subject 1

	Skills										
	A	F	B	G	C	H	D	I	E	J	
Baseline	.31	.30	<u>.15</u>	.08	<u>.19</u>	<u>.12</u>	<u>.08</u>	.40	.04	.00	
Treatment$_1$	-.04	-.04	.06	.08	-.13	.04	.08	.04	.00	-.08	
Treatment$_2$	<u>.00</u> .10	.03	.00	.18	.08	<u>.20</u> .10	.00	<u>-.10</u> .00	.03	.13	SLOPES
Post-treatment	.00	.06	.00	<u>.56</u> .31	.17	.00	.00	.00	.13	.13	

	A	F	B	G	C	H	D	I	E	J	
Baseline	7	5	<u>5</u>	1	<u>3</u>	<u>5</u>	<u>5</u>	5	5	2	
Treatment$_1$	3	1	2	6	5	3	2	5	4	4	
Treatment$_2$	<u>2</u> 3	3	5	7	5	<u>5</u> 4	3	<u>3</u> 4	3	5	RANGES
Post-treatment	4	3	2	<u>6</u> 4	6	3	4	5	5	5	

	A	F	B	G	C	H	D	I	E	J	
Baseline	4.6	4.7	<u>6.6</u>	1.2	<u>6.5</u>	<u>6.9</u>	<u>7.1</u>	4.6	3.2	1.9	
Treatment$_1$	6.9	5.6	4.8	3.3	5.2	5.3	6.4	6.4	3.9	2.6	
Treatment$_2$	<u>7.1</u> 2.1	5.8	6.0	3.9	6.0	<u>5.9</u> 4.8	6.2	<u>6.9</u> 5.9	4.7	3.7	LEVELS
Post-treatment	2.6	5.8	6.8	<u>4.8</u> 5.1	7.3	4.4	6.4	6.3	4.2	4.1	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

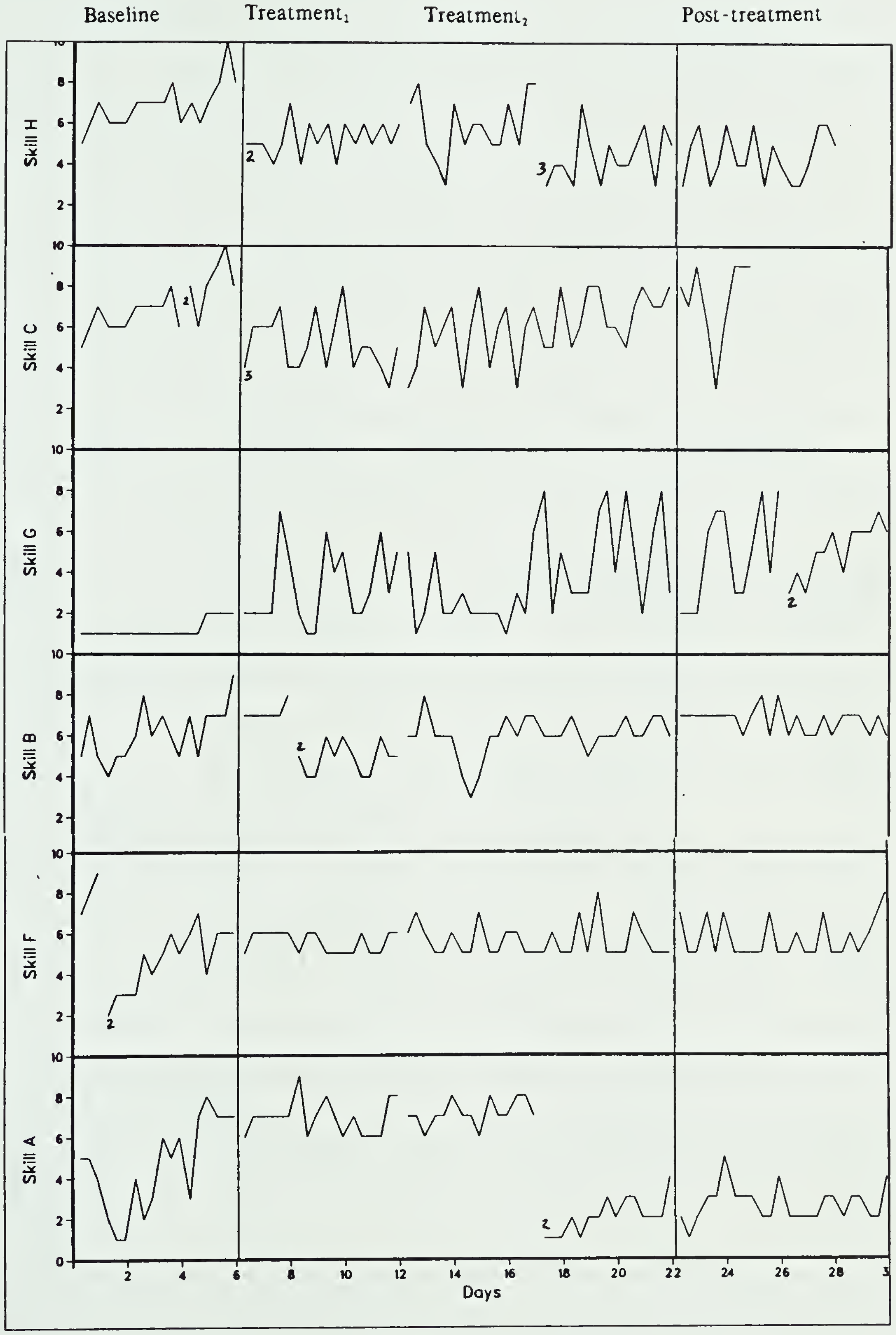

Figure 26. Performance Scores: Subject 1

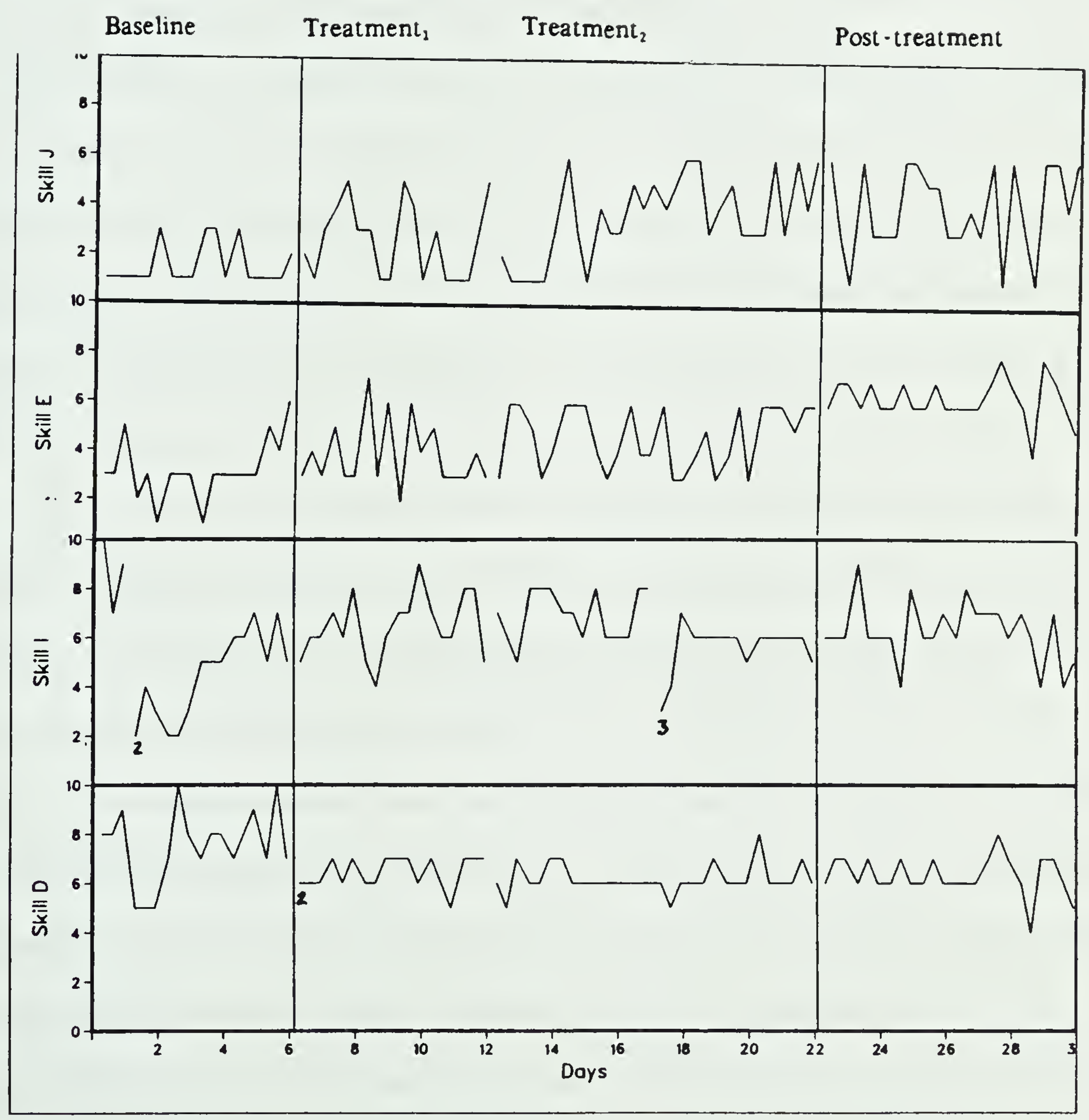

Figure 27. Performance Scores: Subject 1

of the treatment to skill performance was extended for this skill, there is little evidence that the treatment directly affected her performance on this skill.

Another of the high-stress skills, (C), for Subject 1 revealed an increase in slope (+0.21), no change in variability and an increase in level of +0.80. The slope changed from negative in treatment$_1$ to positive in treatment$_2$, due to a drop in scores at the end of treatment$_1$, as well as a rise at the end of treatment$_2$. Although the variability within treatment$_2$ was the same as that of treatment$_1$, the data in Figure 26 indicate that the scores did not increase above the highest level achieved in treatment$_1$, but there were fewer of the lower scores during the last half of the treatment$_2$ phase. Thus, there was a positive change in the subject's performance on Skill C at this point of the treatment$_2$ phase.

This change, seen in Skill C, was not evident in the low-stress skill (D). The slope from treatment$_1$ to treatment$_2$ decreased, leveling off at a lower level (6.4 to 6.2). In addition, during post-treatment, the increased performance continued for the high-stress skill (C) while the performance on the low-stress skill (D) seemed to remain the same throughout the twelve week period of treatment and post-treatment. Due to the nature of the skill, Skill C could be classified as a higher risk skill than Skill G or A, particularly the progressive stages at which Subject 1 was performing. In view of this, a comparison of the data of the high-stress (C) and low-stress (D) skills for Subject 1 showed a difference in direction of all three analysis components; slope, range and level. Performance changes may have been due to the effect of practice. However, if this were true, the performance on Skill D should have increased not decreased. Examining these skills in the post-treatment phase, Skill C showed a continued increase in slope and a substantial increase in level. The increased variability was mainly due to higher performance scores, which were above those in either of the treatment phases. The low-stress skill (D) showed no change in slope (.00) and only a slight increase in level (+0.20). The range increased by one score, which was below those of treatment$_1$ or treatment$_2$.

Skills B, D, and I showed negative changes in slope (-0.06, -0.08, and -0.14, respectively). Although the slope change for Skill B was negative, a substantial level increase of +1.2 indicated that the flat slope of $treatment_2$ had plateaued at a higher performance level. The increased variability also indicated an improved performance. Skill D showed a 0.00 slope in $treatment_2$, and a slight decreased level, implying no performance improvement.

Subject 1 showed possible evidence for positive treatment intervention on Skills B, H, F and E. Performance appeared to improve on Skills G and J but not immediately at the onset of the $treatment_2$ phase (Figures 26, 27). Thus, this improvement may have been an affect of practice. A difference between the performance pattern on the high-stress skill (C) and the low-stress skill (D) was apparent. Although it did not occur at the onset of $treatment_2$, there was a steady improvement in the performance of Skill C across $treatment_2$ shown by more high scores, fewer low scores and increased level. Skill D, however, showed a slight decrease in level with little change in the performance pattern. These findings are not strong enough to provide conclusive evidence in support of the hypothesis but they do show that a possible intervention effect may have influenced her performance.

Subject 2

Figure 25 shows that the total stress rating for Subject 2 decreased from the lowest pre-test score of 111 to a post-test score of 78. There was quite a substantial difference in the ratings, with the uneven bar skills (A, B, C, D, and E) being rated as quite a bit more stressful than the balance beam skills. These findings correlated positively with her least and most favorite gymnastic events. An increase at post-test time was shown on Skills F and H, both of which were among the low-stress balance beam skills for Subject 2 (Table 17, #2). The data for these skills, which are both balance beam skills and of low-stress to Subject 2, may show the subject's frustration of not being able to perform as well as she wanted to on skills, of which she had little fear and which were on her favorite gymnastic event, balance beam. Except for Skill A, the high-stress skills (B, C, and D) showed the greatest decreases in

Table 17
Stress Ratings of Skill Progressions
Subject 2

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		2	2	5	2	3	3	3	3	1	1	
2. Total Stress Ratings	Pre	21	2	16	3	30	8	17	0	10	4	111
	Post	20	8	0	0	20	26	1	0	3	0	78
	Change	-1	+6	-16	-3	-10	+18	-16	0	-7	-4	
3. Total Stress Ratings of Progressions Performed	Pre	1	0	16	0	9	2	4	0	0	0	32
	Post	5	0	0	0	1	5	1	0	0	0	12
	Change	+4	0	-16	0	-8	+3	-3	0	0	0	
4. Pre-Test Stress Rankings		8	1	8	1	9	2	7	0	6	1	43

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

perceived stress level. An understanding of the concept of "swing", which cannot be taught but must be kinesthetically felt, is required for Skill A. Subject 2 expressed her frustration at not being able to "feel" this movement pattern, resulting in poor performance on this skill. This may have accounted for the maintenance of a relatively high stress rating for Skill A.

In addition to showing an overall reduction in stress level, the data for only the skill progressions she had performed during this study (Table 17, #3), also showed a reduced perception of stress from 32 to 12. These data showed an increased stress rating on Skills A and H. This reinforces the findings for these skills in the total scores analysis, using the total skill ratings (Table 17, #3). It seems from the low overall stress levels for Subject 2, it is the final skill that is perceived as stressful. The skill progressions leading up to the final skill seem to evoke stress in the form of frustration, from not being able to perform as well as she expected from herself.

Performance Skills

There were increases of performance slopes on five skills (F, B, C, D, and I) for Subject 2 (Table 18). Of these skills, increases of +0.11 and +0.14 for Skills F and C showed changes from slightly negative slopes during $treatment_1$ (-0.04) to positive slopes of +0.07 and +0.10, respectively, during $treatment_2$. A drop in performance at the beginning of $treatment_2$ for Skill F accounted for its increased slope. Figure 28 shows that performance scores in $treatment_2$ never reached the level attained at the end of the baseline phase. There was only a very slight level increase which confirmed the lack of a substantial performance improvement.

Data on the high-stress skill (C) revealed a change in slope between the treatment phases from slightly negative to positive, accompanied by an increase in variability shown by more high peaks of performance during $treatment_1$ than $treatment_2$. Although there were still several low scores during $treatment_2$, an increase in level of +0.8 was also evident. The reduced amount of data on this skill limited the conclusions to be drawn by the researcher. Even though the slope and level increased, the graphed data in Figure 28 shows this was not a noticeable change occurring at the onset of $treatment_2$. Although the treatment may have

Table 18
Slopes, Ranges, and Levels of Performance Data
Subject 2

	A	F	B	G	C	H	D	I	E	J	
Baseline	.17 .17	.40	.17	.50 .17	.63	.13	.00	.00	.25	.13	
Treatment$_1$	.00	-.04	.06	.13	-.04	.13	.00	.04	.08	.17	
Treatment$_2$	.00	.07	.13 .00	.08	.10	.19	.05	.05	.00	-.07	SLOPES
Post-treatment	.19	-.09	-.06	.00	---	--	.06 .19	.00	.00	.13	

	A	F	B	G	C	H	D	I	E	J	
Baseline	6 1	6	3	9 2	6	6	2	5	5	3	
Treatment$_1$	4	3	2	3	5	4	1	3	5	3	
Treatment$_2$	6	4	2 4	4	7	8	2	2	5	5	RANGES
Post-treatment	2	4	1	3	---	--	2 3	5	6	3	

	A	F	B	G	C	H	D	I	E	J	
Baseline	6.7 4.5	4.5	6.3	6.7 2.7	6.6 7.7	6.3	6.7	6.7	4.7	4.4	
Treatment$_1$	1.8	5.3	6.0	4.8	3.3	7.7	6.2	7.5	5.2	4.7	
Treatment$_2$	2.4	5.5	7.2 6.2	5.5	4.1	6.0	6.7	7.2	6.3	5.9	LEVELS
Post-treatment	2.8	5.3	6.5 7.8	6.7 7.1	---	--	7.3 3.4	6.5	6.6	6.5	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

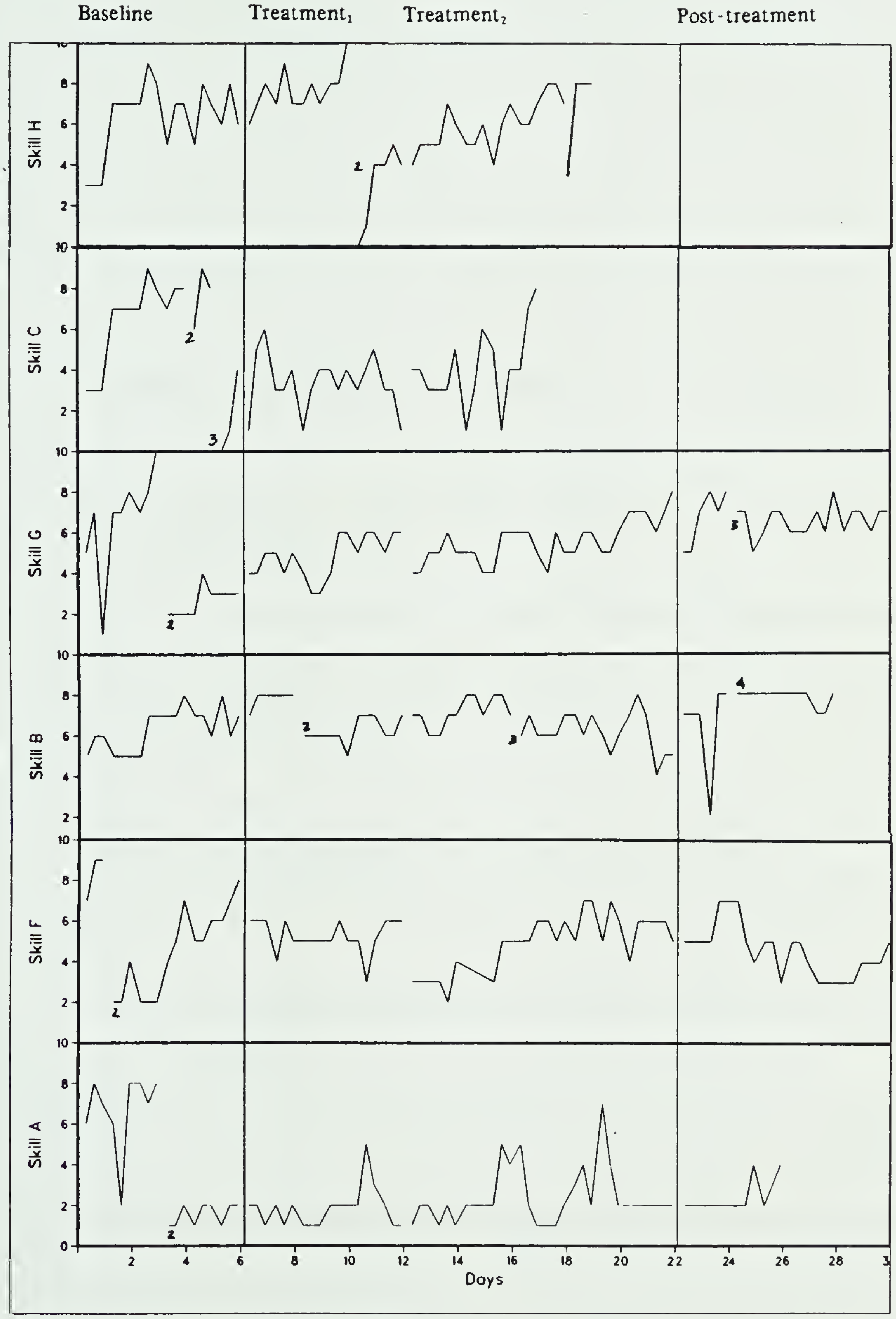

Figure 28. Performance Scores: Subject 2

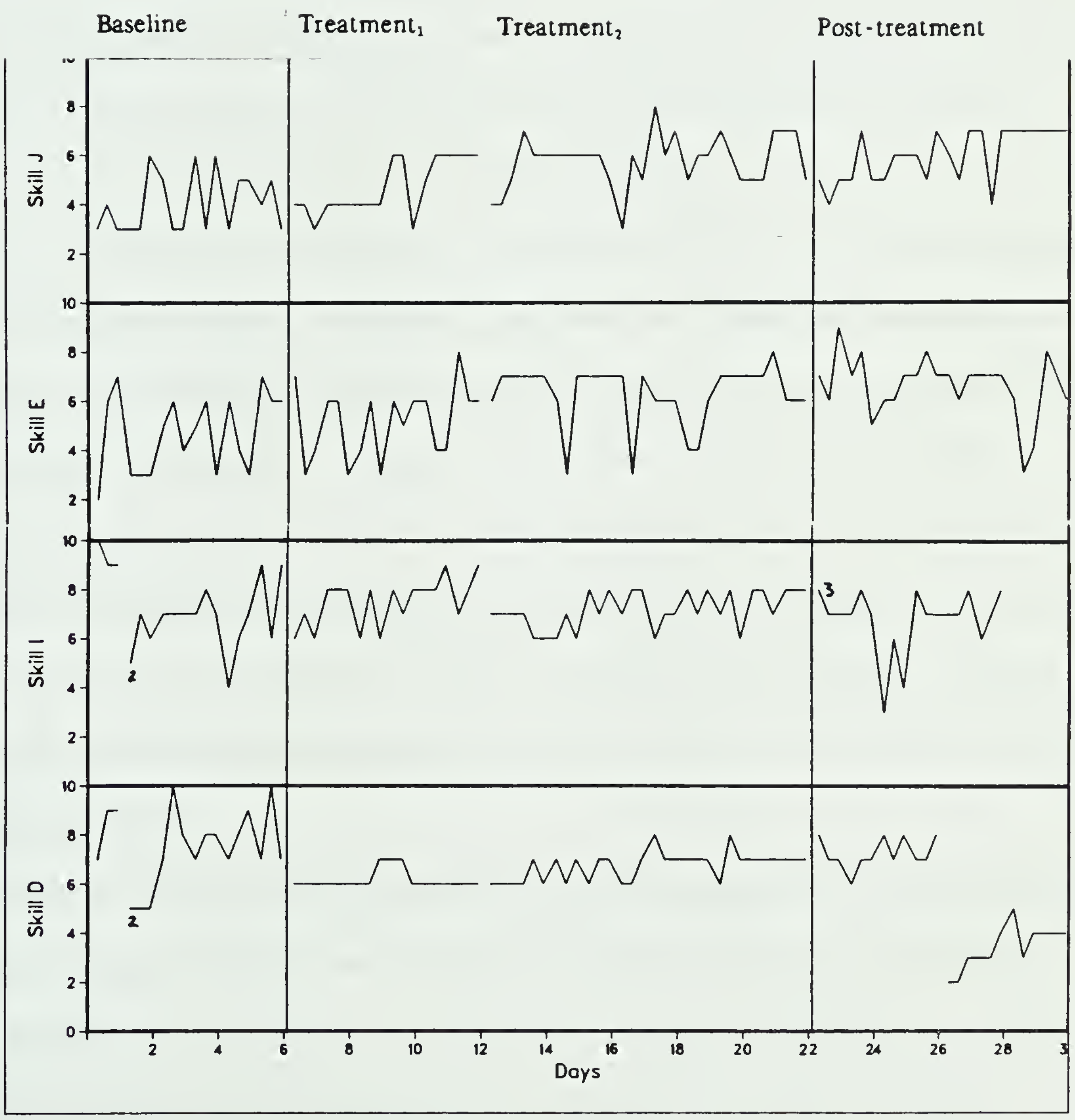

Figure 29. Performance Scores: Subject 2

affected performance on this skill, it is not conclusive from the amount of data available.

The low-stress skill (I) did not show evidence of improved performance at the onset of $treatment_2$. In fact, there was a slight drop toward the low scores at the beginning of $treatment_2$. Accordingly, an increase in slope was evident for this phase as the performance again improved to its original level. The performance level of this skill was near the criterion scores for moving to the subsequent skill progression, leaving little room to improve on this progression. However, this does not explain the inconsistent high scores. The actual performance decreased slightly, indicated by the decreased range and level (Table 18). Had a positive effect from practice, treatment, or a combination thereof, affected the consistency and improvement of performance on this skill, this subject should have changed skill progressions prior to Day 23. There was evidence in the data at the end of the baseline and $treatment_1$ phases, that this improved performance was physically possible.

When comparing them in $treatment_1$ to $treatment_2$, Skills G, E, and J showed decreased slopes. Skill G continued to show an increase in performance although at a lesser rate than during $treatment_1$. The increased range for Skill G was caused by a rise in performance toward the end of $treatment_2$. Although this appears to show a change in performance during $treatment_2$, this change does not occur until half way through this phase, indicating that perhaps a factor other than the unstressing treatment affected the performance. On the other hand, this change could be attributed to a longer time necessary for this subject to become familiar enough with the unstressing technique to be able to apply it to her performance on this particular gymnastic skill.

Skills E and J (matched skills) showed performance changes inconsistent with each other. A slope change for Skill E from +0.08 to 0.00 between $treatment_1$ and $treatment_2$, indicated a leveling off of performance at a higher level that that of $treatment_1$ (+1.1 level change). The treatment may have contributed to the increased consistency at a higher performance level of Skill E during $treatment_2$. Performance on Skill J leveled and slightly decreased during $treatment_2$, indicated by the change in slope from +0.17 in $treatment_1$ to

-0.07 in $treatment_2$.

Skill H showed fairly high positive slopes in all phases of the study. For the second skill progression, there were not enough data points at the end of $treatment_1$ to calculate the slope and range values. Even though it appears that performance showed an improvement in $treatment_2$, the slope values in all phases (baseline, $treatment_1$, and $treatment_2$) were similar, indicating that there was no performance change during $treatment_2$. The range of $treatment_2$ data showed an increase of one score above those in $treatment_1$ accompanied by a substantial increase in level (Table 18). Visual examination of the data (Figure 28) indicates that these changes occurred prior to the onset of $treatment_2$. Several reasons may be used to explain these results. The subject may have begun to apply the unstressing treatment to performance sooner than the date arbitrarily chosen by the researcher as the time when the application of the treatment to performance may have occurred. Another possibility is that a factor other than the treatment (e.g. mere practice of the skill) caused these performance changes. Or, the combination of practice of the skill and the application of the unstressing technique to performance may have contributed to performance changes.

Data for Subject 2 showed some support in Skills D, E, and J. Although Skills G and C showed improved performance during $treatment_2$, there was a time lag between the beginning of $treatment_2$ and the performance change (Figures 28, 29). Therefore, these data do not either strongly support, nor do they refute the expected outcome. There is some performance improvement during $treatment_2$ shown on data of Skill C (high-stress skill) initiated after a time lag (Day 14). Skill I (the low-stress skill) showed no performance improvement. Although the treatment may have affected the performance of several of the skills, as indicated by the comparison of the high-stress to low-stress skill, it is possible that other factors contributed to the change as well.

Subject 3

Subject 3 was the only experimental subject to show an increase in overall stress rating from pre-test to post-test (Figure 25). Examining the individual skills, six out of the ten showed an increase (Table 19). The largest increase was on Skill F, for which Subject 3 seemed to exhibit more frustration in dealing with changing the place of performance for this skill from the floor to the narrow balance beam. The largest changes in stress level seemed to occur on progressions of skills, which required a more noticeable alteration within the apparatus (Skills F, E, and H). Skill F, which showed an increased stress rating of +23, required the skill in progression 2 to be done on the narrow balance beam. Skill E required an adaptation of the skill onto the low parallel bars. Skill H required the front salto to be done onto a height. The increased stress level for Skills J and D may have been caused by the frustration of inconsistency of her performance on the beginning progressions. Skill G also showed a slight increase which was influenced by the subject attempting to apply the "swing" concept to this balance beam skill. The relatively low stress rating of Skill G (Table 19, #4) justifies this stress rating to be due to frustration in performance level as opposed to the risk factor of the skill itself.

When examining the progressions for each skill that Subject 2 had attempted during the study (Table 19, #3), the only skills which showed an increase in stress ratings were Skills E and F, which were also ranked as low-stress skills. The high-stress skills (C and H) showed decreased stress ratings. These data reveal that the skill progressions Subject 3 had attempted were perceived as being less stressful than those she had not attempted. Since the high-stress skills were shown to decrease in stress level, the unstressing treatment may have affected her perception of the stressfulness of these skills.

Performance Skills

Of the five skills (A, H, I, E, and J) that showed positive slope differences between treatment_1 and treatment_2, that of Skill E was the most dramatic, showing a change from -0.08 to +0.10 (Table 20). This increase in slope continued steadily throughout post-treatment as

Table 19
Stress Ratings of Skill Progressions
Subject 3

		Skill A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		2	2	1	1	3	2	2	2	2	1	
2. Total Stress Ratings	Pre	16	4	11	8	32	25	10	5	8	3	122
	Post	14	27	9	10	27	28	12	4	15	7	153
	Change	-2	+23	-2	+2	-5	+3	+2	-1	+7	+4	
3. Total Stress Ratings of Progressions Performed	Pre	3	0	0	0	9	4	0	0	1	0	17
	Post	2	5	0	0	2	3	0	0	2	0	14
	Change	-1	+5	0	0	-7	-1	0	0	+1	0	
4. Pre-Test Stress Rankings		5	2	7	3	9	9	4	3	3	1	46

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

indicated by the level changes. The range of scores also increased showing improved performance.

Skill B was the only skill which demonstrated a decrease in slope (0.00 to -0.05). However, this skill showed no change in level and an increase in variability. When examined visually, the performance seemed to lack consistency and showed no signs of improvement.

Skill C (high-stress skill) showed a positive slope (+0.10) during $treatment_2$. A change to the second skill progression occurred towards the end of $treatment_1$, which resulted in too few data points from which an adequate slope and range could be calculated. The level of performance did increase from 4.0 to 6.0, yet the high variability implied inconsistency in performance during $treatment_2$ (Figure 30). A decrease in slope, range, and level for Skill C between $treatment_2$ and post-treatment phases implies that either the treatment was not the sole factor affecting performance, or if it did have an effect, it did not show a maintenance effect on performance.

Skill J, the low-stress skill exhibited a decrease in slope, increased variability due to lower performance scores, and a slight decrease in level (-0.50). There was seemingly no performance improvement shown on this skill.

The performance pattern of Skill E for Subject 3 showed a definite upward trend during $treatment_2$ which continued during the post-treatment phase (Figure 31). This implies that the treatment as well the effect of practice may have had a positive effect on this subject's performance on Skill E. The high-stress (C) and low-stress (J) skills could not be effectively compared because of the change in skill progression for Skill C at the end of $treatment_1$.

Subject 4

Subject 4 showed the largest decrease in overall stress ratings of skills of any of the experimental subjects (Figure 25). Table 21 shows that all skills decreased on the post-test except Skill D. Since Skill D was considered to be unstressful to Subject 4 at pre-test time, the increased stress level at post-test time may have been due to the frustration of her performance

Table 20
Slopes, Ranges, and Levels of Performance Data
Subject 3

Skills

	A	F	B	G	C	H	D	I	E	J	
Baseline	.00	.04	.08	-.04	$\underline{.21}$	$\underline{.20}$	.00	.00	-.20	.00	
Treatment$_1$	-.08	$\underline{-.17}$	.00	.00	$\underline{.00}$	-.04	.00	-.04	-.08	-.04	
Treatment$_2$	.00	.06	-.05	.00	.10	.00	.00	.03	.10	.00	SLOPES
Post-treatment	-.13	.00	-.06	-.14	.00	.06	.00	.00	.13	.00	

	A	F	B	G	C	H	D	I	E	J	
Baseline	3	5	3	5	$\underline{5}$	$\underline{5}$	3	2	2	4	
Treatment$_1$	5	$\underline{6}$	2	6	$\underline{1}$	2	2	5	2	3	
Treatment$_2$	5	3	4	6	5	2	4	4	4	4	RANGES
Post-treatment	4	6	2	6	4	3	4	5	3	6	

	A	F	B	G	C	H	D	I	E	J	
Baseline	3.1	6.1	5.8	1.4	$\underline{6.7}$	$\underline{6.3}$	6.3	6.4	4.1	6.1	
Treatment$_1$	4.9	$\underline{6.1}$	7.0	3.4	$\underline{7.2}$ 4.0	3.7	6.5	5.9	3.3	6.3	
Treatment$_2$	4.6	2.7	7.0	2.7	6.0	3.7	6.2	6.4	4.2	5.8	LEVELS
Post-treatment	3.9	2.5	7.2	2.7	5.6	4.3	6.6	5.6	5.7	5.2	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

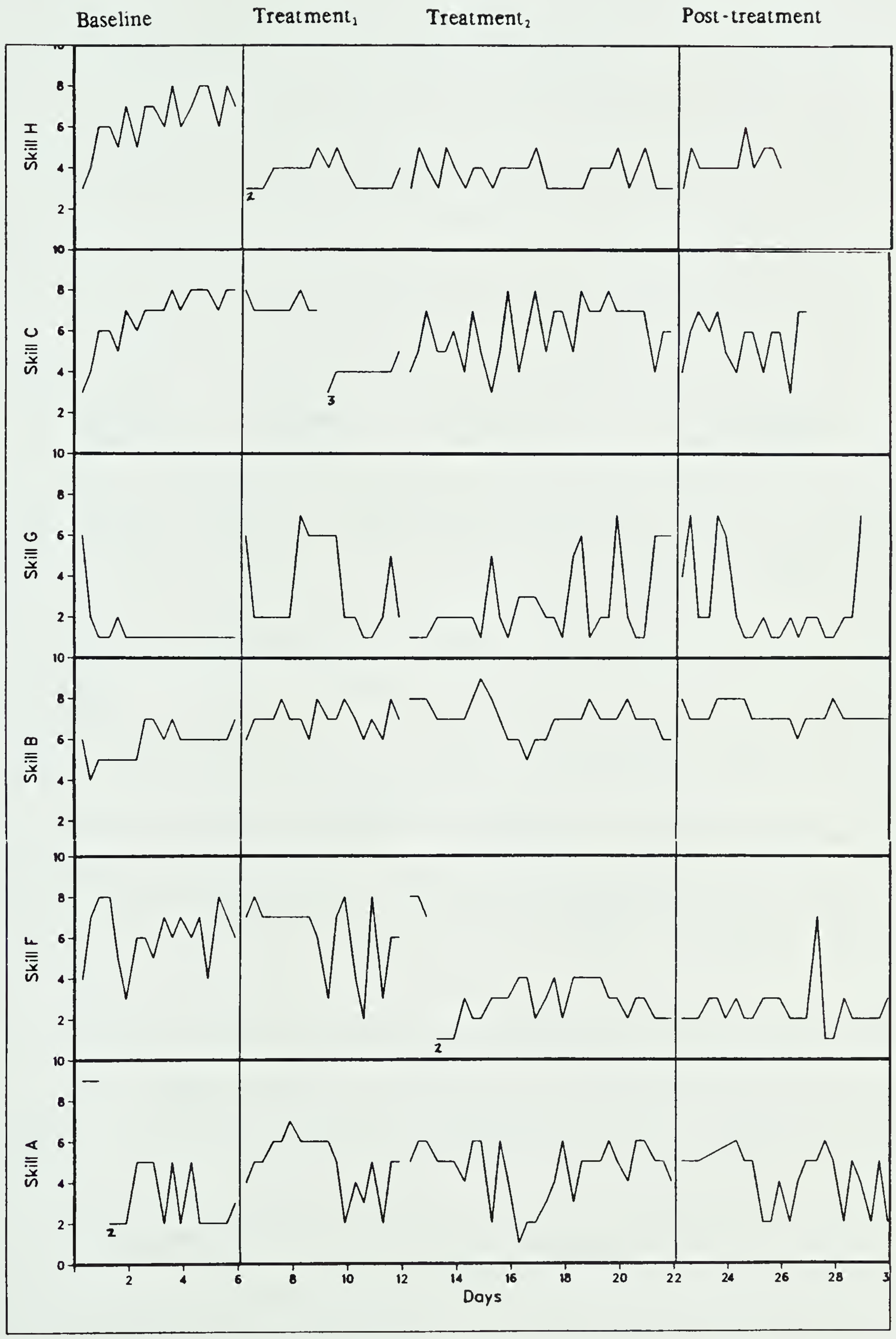

Figure 30. Performance Scores: Subject 3

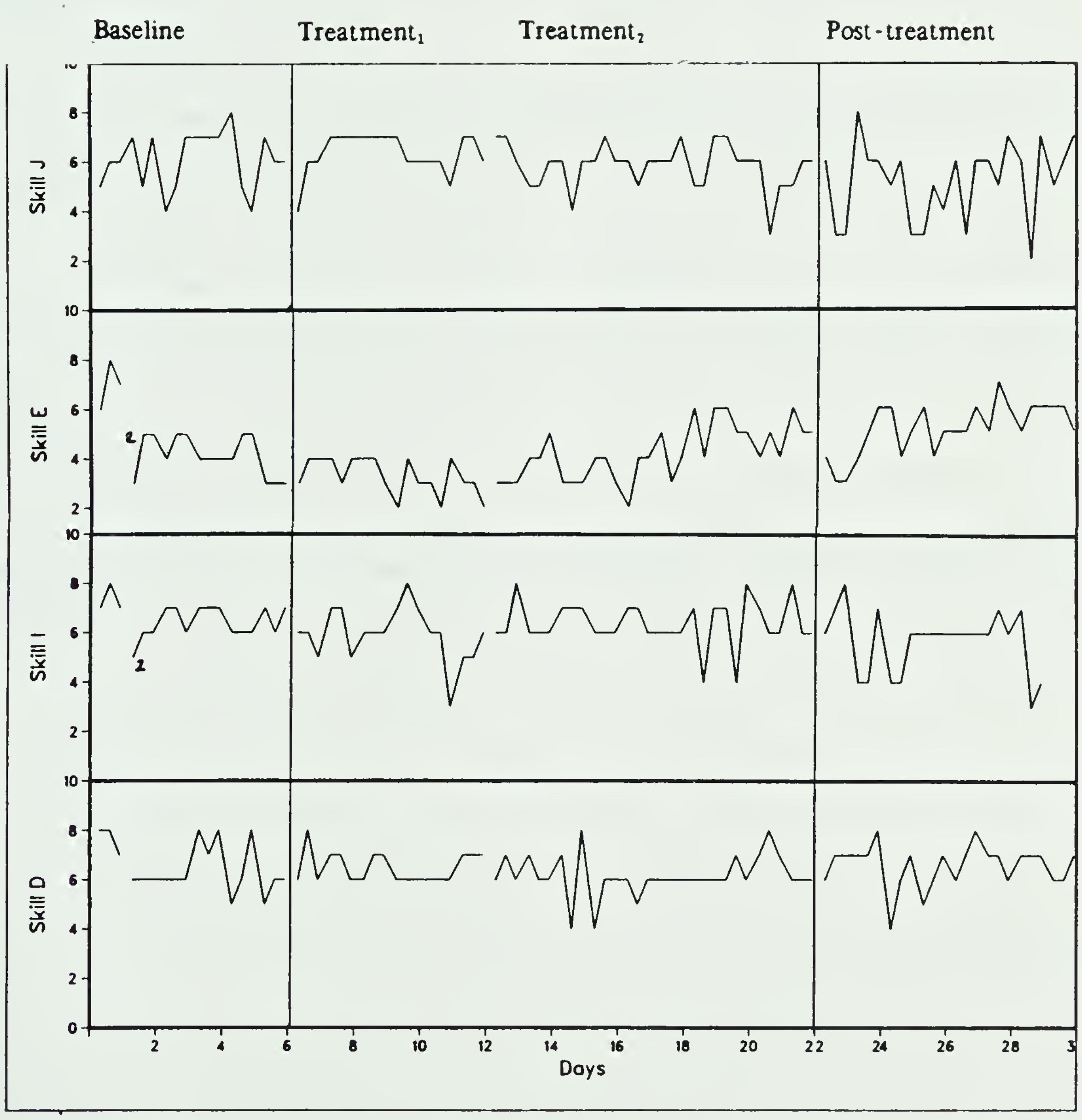

Figure 31. Performance Scores: Subject 3

Table 21
Stress Ratings of Skill Progressions
Subject 4

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		5	2	5	3	3	2	3	4	1	1	
2. Total Stress Ratings	Pre	14	27	0	0	47	50	0	4	13	7	162
	Post	8	15	0	0	28	39	10	3	9	2	114
	Change	-6	-12	0	0	-19	-11	+10	-1	-4	-5	
3. Total Stress Ratings of Progressions Performed	Pre	14	7	0	0	23	14	0	0	0	0	58
	Post	8	0	0	0	1	3	3	0	0	0	15
	Change	-6	-7	0	0	-22	-11	+3	0	0	0	
4. Pre-Test Stress Rankings		6	6	0	0	8	9	0	4	7	3	43

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

on this skill. It may have also been caused by the change to progression 3, which required the subject to perform the skill onto a four-foot bar. The data do in fact show that the stress level of the third progression did increase from pre-test to post-test, as a result of Subject 4 actually performing the skill progression.

The high-stress skills (C and H) showed substantial decreases in stress ratings, both when considering all progressions and only those the subject had performed in the study (Table 21, #2,3). The fact that Skills C and H did show such large decreases may indicate that the unstressing treatment influenced her perception of the skill progressions. The other two unstressful skills, B and G were perceived as having no stress during pre-test or post-test.

Performance Skills

Of the three skills showing increased slopes during treatment$_2$, those of Skills F and C changed from negative slopes in treatment$_1$ (-0.17, -0.08) to positive slopes in treatment$_2$ (0.00, +0.10) (Table 22). Skill F, however, after showing a steady increase in performance during baseline, showed a plateau of performance around the mean of treatment$_1$ (Figure 32). Thus, there seemed to be no positive change between treatment$_1$ and treatment$_2$. Performance during treatment$_2$ never reached the high point at the beginning of treatment$_1$.

Skill C showed a decline during treatment$_1$ (slope: -0.08) which leveled off towards the end of treatment$_1$, and during treatment$_2$ returned to the level at which it was at the beginning of treatment$_1$. Even though there was a slight decrease in variability and level in treatment$_2$, the graphed data does not show any resultant change in performance.

A continued steady increase in slope was found for Skill A (+0.13 to +0.17). Variability decreased limiting performance to scores in a narrow range at the top end of the scale. The convincing level change (+1.50) was evident from the graphed data (Figure 32). A change in the performance data for this skill appeared to occur during the early part of treatment$_1$ showing increased consistency (with a range of one score) throughout that phase and an increase in performance during treatment$_2$. Thus, if the treatment affected the subject's performance on this skill, it may have done so at an earlier time during the treatment

Table 22
Slopes, Ranges, and Levels of Performance Data
Subject 4[20]

	Skills										
	A	F	B	G	C	H	D	I	E	J	
Baseline	.33 .03	.14	.03	.00	.25 .31	.08	.06	.00	.00	.00	
Treatment$_1$	.13	-.17	---	.00	-.08	.25	.17	.00	.00	.00	
Treatment$_2$	.17	.00	---	-.05	.10	.00	.07	.00	-.06	.00	SLOPES
Post-treatment	----	----	----	----	----	----	----	----	----	---	

	A	F	B	G	C	H	D	I	E	J	
Baseline	2 5	4	2	4	5 4	4	6	3	5	6	
Treatment$_1$	4	3	---	2	5	5	5	2	3	3	
Treatment$_2$	3	4	---	4	4	4	5	3	5	6	RANGES
Post-treatment	---	---	---	---	---	---	---	---	---	--	

	A	F	B	G	C	H	D	I	E	J	
Baseline	7.1 5.7	3.4	8.2	6.9	7.1 4.0	7.0	4.3	5.4	3.9	3.2	
Treatment$_1$	6.1	5.4	---	7.9 6.3	5.4	5.7	5.2	5.2	3.7	2.8	
Treatment$_2$	7.6	5.2	---	6.8	5.8	5.9	5.1	5.9	4.3	3.3	LEVELS
Post-treatment	---	---	---	---	---	---	---	---	---	--	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

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[20]Subject 4 achieved criterion level for the last progression of this skill on Day 13. Thereafter, this skill was omitted from her skill repertoire during performance testing.

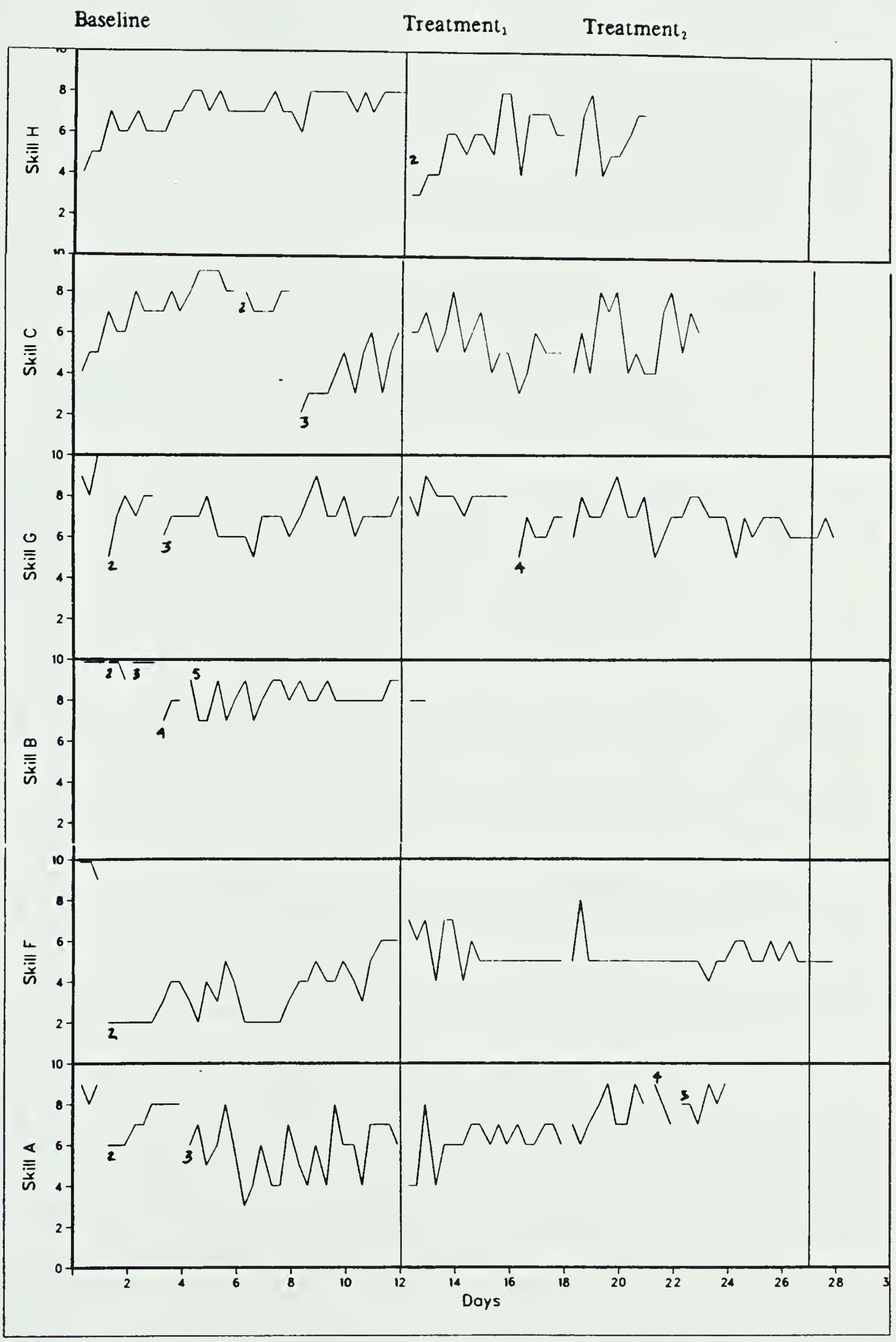

Figure 32. Performance Scores: Subject 4

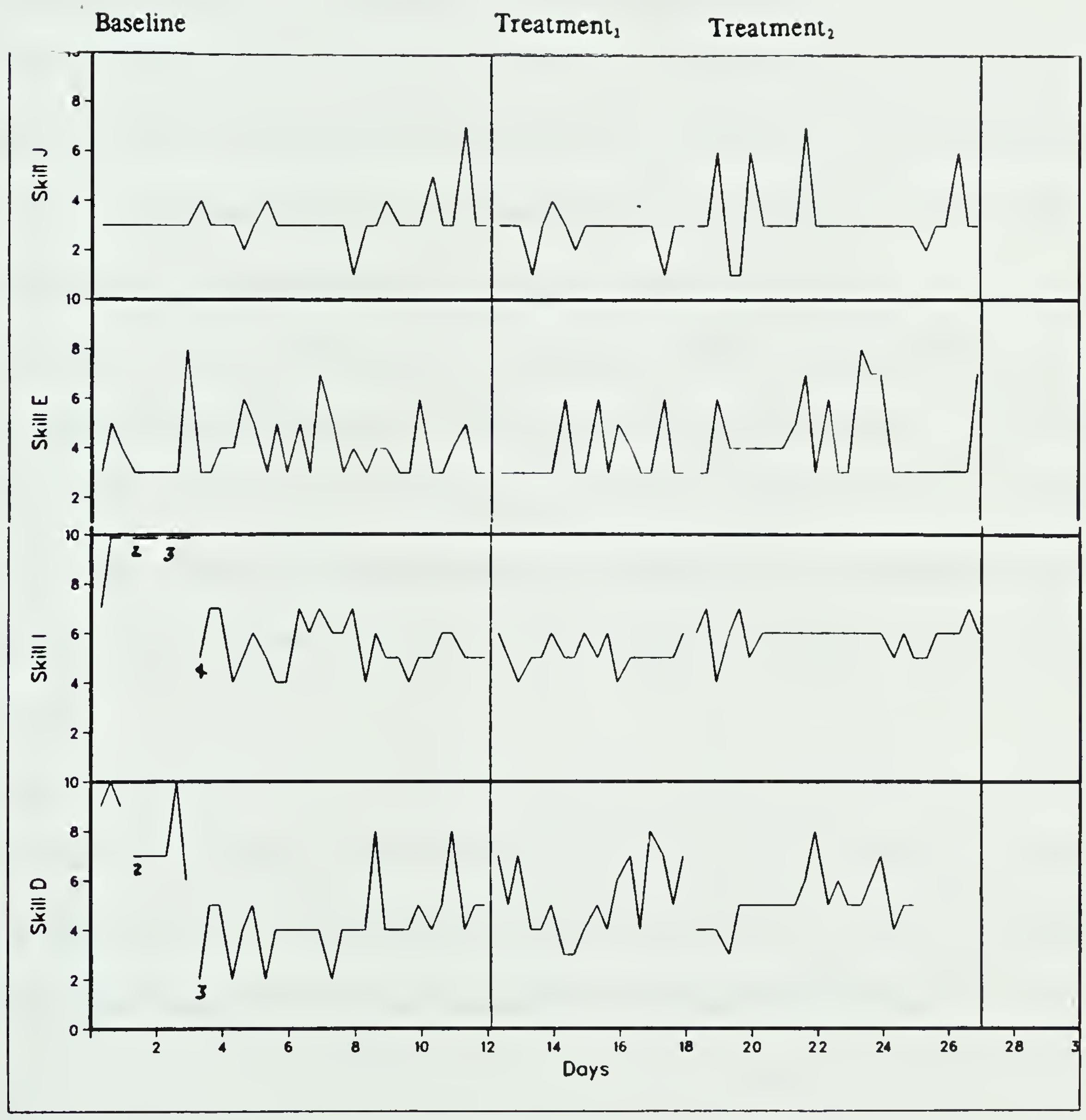

Figure 33. Performance Scores: Subject 4

phase (e.g. Day 3 of $treatment_1$). This is a rather unlikely occurrence, given the amount of time it takes to become familiar with the unstressing training, and the fact that the treatment was not promoted in any way during the performance sessions.

Skills H, D, and E showed negative slope changes. Skill H (high-stress skill) showed a dramatic increase in performance during $treatment_1$ when the subject began a new skill progression. The change in slopes (+0.25 to 0.00) exhibited the plateau of performance during $treatment_2$. Limited data points during $treatment_2$ restricted trend comparison between the treatment phases. Performance in $treatment_1$ did not appear to differ from that of $treatment_2$, and therefore was assumed to be unsupportive of a treatment effect.

Performance on Skill D (the low-stress skill) showed a drop in performance at the beginning of $treatment_2$ and then a slow increase back to its level at the end of $treatment_1$ (Figure 33). A very slight decrease in level and no change in variability confirmed that this skill did not support the expected slope increase and variability decrease.

Change to a negative slope during $treatment_2$ for Skill E was accounted for by the high scores at the beginning of $treatment_2$, which did not occur during $treatment_1$. $Treatment_2$ also showed increased variability (due to improved performance on several occasions) and increased level (3.7 to 4.3). However, this performance pattern was also seen at the end of the baseline phase. Consequently, it appears that there was no evidence of change in performance due to the treatment.

Some support for improved performance duing $treatment_2$ was evident in Skills A, I, E, and J for Subject 4. The high- and low-stress skills (H and D) showed no such trend, partially due to the limited number of data points in $treatment_2$ for Skill H. Thus, data for Subject 4 showed no supportive evidence for the expectancies of the research questions.

Subject 5

The overall stress rating of skills for Subject 5 decreased slightly at post-test, from 115 to 104 (Figure 25). The four skills which showed increased post-test stress ratings were all

uneven bar skills (Table 23, #2). The skill level of this subject only allowed her to progress past the first progression on one skill, Skill C. It was this skill that showed the greatest increase in stress both as a total skill[21] (Table 23, #2), and when only using the stress ratings for the first two progressions (Table 23, #3). The stress ratings of the progressions she performed were predominantly "0" or "1". Therefore, for most of these skills, there seemed to be an element of frustration as opposed to fear that influenced these stress ratings. The low progression levels attained on each skill, and the low stress ratings of those progressions, do not yield substantial evidence to advocate a treatment effect on Subject 5's stress perception of these skills.

Performance Skills

Increased slopes were evident in performance data of Skills F, C, H, D, and I for Subject 5 (Table 24). The only substantial changes were those of Skill C (0.00 to +0.25) and Skill H (0.00 to +0.06)[22]. Both skills showed an increase in variability, due to improved performance, as well as a convincing increase in level (+3.1 and +2.7, respectively). Skill H, the high-stress skill for Subject 5, showed support for the possible effect of the treatment on performance through the increased slope occurring at the beginning of $treatment_2$ (Figure 34). The low-stress skill (I) did not show such a dramatic performance change (Figure 35). Although there was a change in slope from -0.08 in $treatment_1$ to 0.00 in $treatment_2$, this negative slope was primarily due to a slightly higher performance level at the beginning of $treatment_1$ which decreased. The unchanged range and level of performance along with visual analysis of the data, further confirmed a lack of performance change between the treatment phases of this skill.

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[21] Skills A and G for Subject 5 could not be evaluated for this study. The subject did not have the physical ability to perform the first progression of these skills without manual support (spotting). Thus, performance scores for these skills remained at a score of "1" throughout the study.

[22] The first progression for Skills C and H was the same skill, with the only difference being the landing position. Only one set of fifteen trials of this skill progression was performed each day, the scores of which were recorded for progression one of both Skill C and Skill H. Therefore, the scores for these two skills show a very similar trend until Subject 5 moved on to progression two at the end of the $treatment_2$ phase.

Table 23
Stress Ratings of Skill Progressions
Subject 5

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		1	1	1	1	2	1	1	1	1	1	
2. Total Stress Ratings	Pre	13	14	6	5	11	30	6	5	11	14	115
	Post	20	7	8	0	23	27	8	3	6	2	104
	Change	+7	-7	+2	-5	+12	-3	+2	-2	-5	-12	
3. Total Stress Ratings of Progressions Performed	Pre	0	2	0	0	0	1	0	0	1	1	5
	Post	0	0	0	0	1	0	0	0	0	0	1
	Change	0	-2	0	0	+1	-1	0	0	-1	-1	
4. Pre-Test Stress Rankings		5	4	3	3	4	7	3	2	5	5	41

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

Table 24
Slopes, Ranges, and Levels of Performance Data
Subject 5

	Skills										
	A	F	B	G	C	H	D	I	E	J	
Baseline	.00	-.04	.04	.00	-.04	.00	.02	.00	.00	.08	
Treatment$_1$	.00	-.04	.08	.00	.00	.00	.00	-.08	.00	.00	
Treatment$_2$	.00	.00	-.07	.00	.25	.06	<u>.06</u>	.00	.00	.00	<u>SLOPES</u>
Post-treatment	----	----	----	----	---	----	----	----	----	---	
	A	F	B	G	C	H	D	I	E	J	
Baseline	0	4	3	0	3	3	3	6	1	2	
Treatment$_1$	0	2	3	0	2	2	4	2	0	2	
Treatment$_2$	0	3	1	0	5	5	<u>4</u>	2	3	4	<u>RANGES</u>
Post-treatment	---	---	---	---	--	---	---	---	---	--	
	A	F	B	G	C	H	D	I	E	J	
Baseline	1.0	2.5	5.4	1.0	2.2	1.8	6.4	5.4	2.9	2.1	
Treatment$_1$	1.0	2.8	6.3	1.0	3.1	2.3	6.1	6.3	3.0	2.9	
Treatment$_2$	1.0	3.4	6.4	1.0	<u>6.2</u> 5.7	5.0	<u>6.4</u>	6.3	3.4	3.1	<u>LEVELS</u>
Post-treatment	---	---	---	---	--	---	---	---	---	--	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

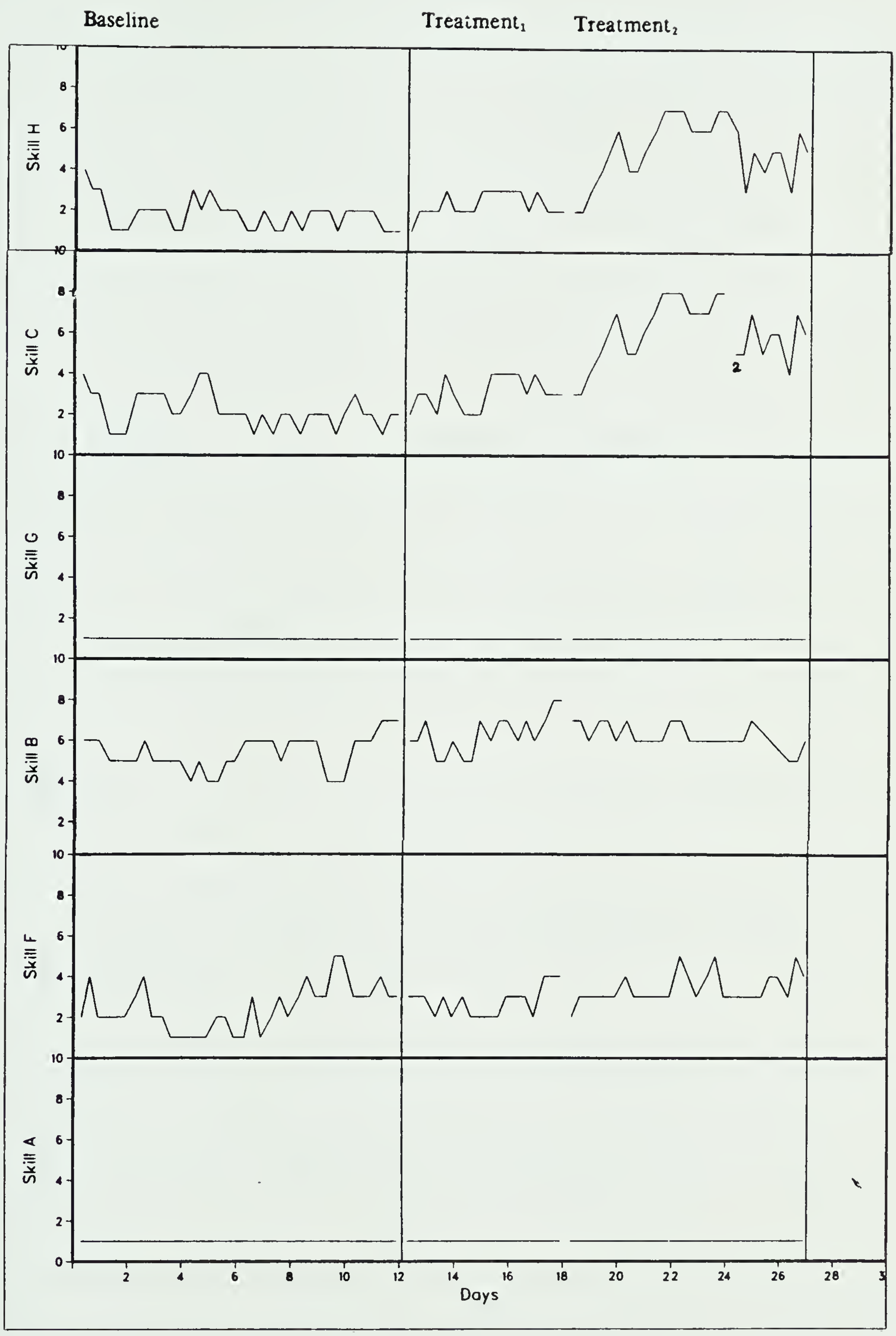

Figure 34. Performance Scores: Subject 5

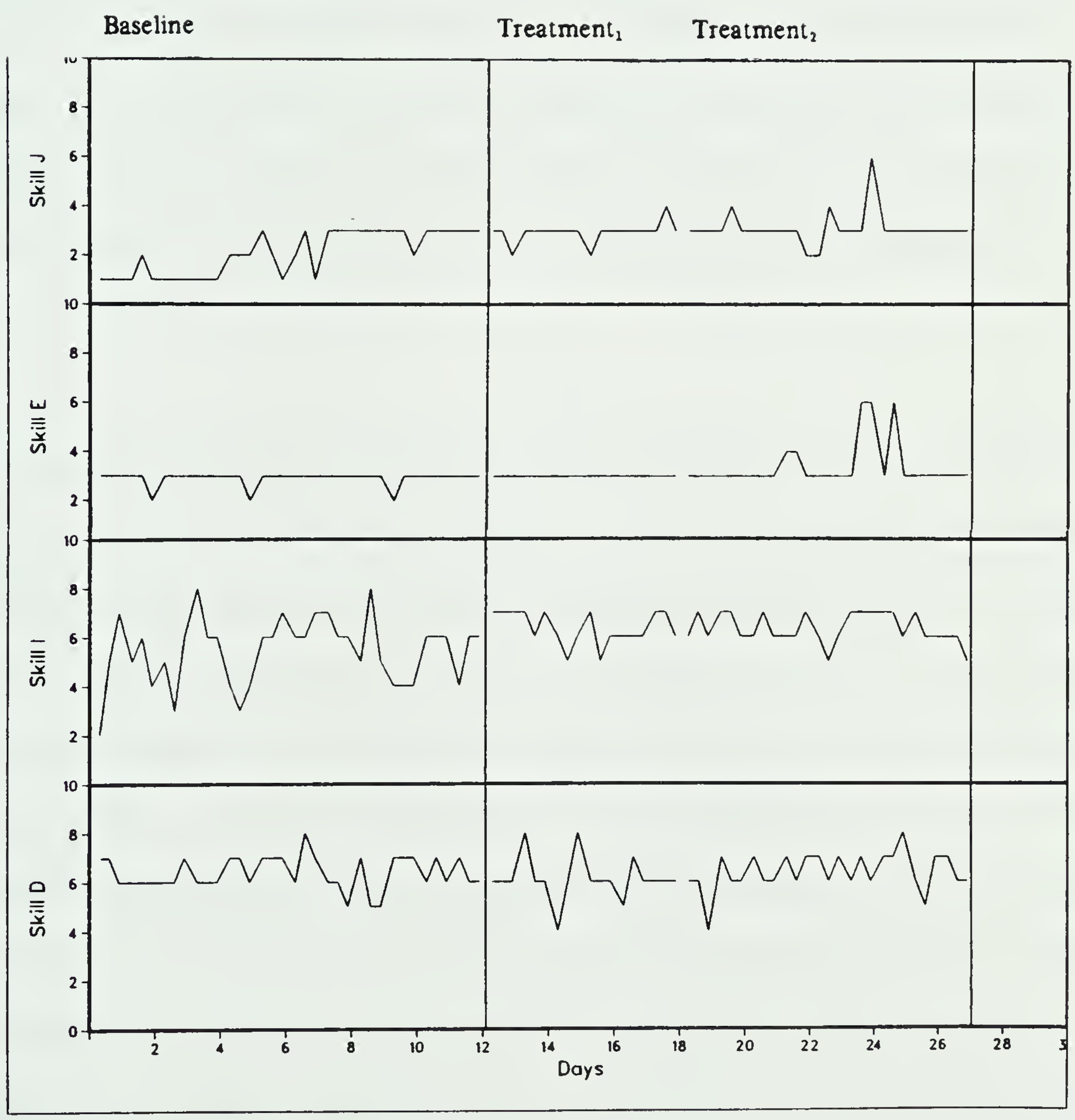

Figure 35. Performance Scores: Subject 5

The only skill to show a decrease in slope for Subject 5 was Skill B (0.08 to -0.07). Figure 34 shows an increasing trend in the data that peaked at the end of $treatment_1$, dropped slightly at the beginning of $treatment_2$ and then plateaued. The variability decreased and the level changed very slightly (6.3 to 6.4) as the performance scores regressed towards the mean level. This skill showed no increased performance during $treatment_2$.

Performance patterns for Skills C and H of Subject 5 were strongly supportive of expectancies within the relevant research question (Figure 34). Skill F also showed a trend toward performance improvement during $treatment_2$. A comparison of data differentiated between the improved performance pattern of Skill H (the high-stress skill), and Skill I (the low-stress skill), which showed no trend toward improved performance. Although this dramatic result may provide strong evidence for the effect of unstressing on performance, the lack of evidence of a similar finding in the other skills for this subject, strongly suggests that perhaps another factor may have contributed to this substantial increase in performance.

Subject 6

The overall stress ratings of the skill decreased for Subject 6 (Figure 25). Skills B, C, and F showed increased stress ratings when using the ratings for all skill progressions (Table 25, #2). However, when using only the progressions she had performed (Table 25, #3), all the skills showed decreased stress ratings. Relative to the changes in the other skills for Subject 6, the two high-stress skills, C and H, did show substantial decreases at post-test time, however not unanimously when examining the stress ratings of all progressions for those skills. These findings support the expectancy that merely experiencing a skill will tend to reduce the subject's perceived stress level for that skill. It is interesting to note for Subject 6 that Skills A and G showed no change in stress level remaining at 18 and 13, respectively. Skill A required a "swing" concept, which Subject 6 had not mastered. Consequently, her performance scores were consistently at a rather low level of 5. Subject 6 was not able to perform Skill G without manual assistance (spotting). Both of these skills proved frustrating for her, which was

Table 25
Stress Ratings of Skill Progressions
Subject 6

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		2	2	2	1	3	3	3	3	1	1	
2. Total Stress Ratings	Pre	18	13	13	13	26	36	9	2	7	5	**142**
	Post	18	15	15	13	27	32	8	0	2	0	130
	Change	0	+2	+2	0	+1	-4	-1	-2	-5	-5	
3. Total Stress Ratings of Progressions Performed	Pre	1	1	1	0	4	12	0	0	0	0	**19**
	Post	0	0	0	0	0	5	0	0	0	0	5
	Change	-1	-1	-1	0	-4	-7	0	0	0	0	
4. Pre-Test Stress Rankings		8	6	6	7	9	9	5	2	5	3	60

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

responsible for their moderate stress ratings.

Performance Skills

Skill D was one of only two skills which showed an increased slope changing from -0.04 during $treatment_1$ to +0.07 during $treatment_2$ (Table 26, Figure 36). Although the ranges within the treatment phases were almost the same, the data for the two phases followed opposite patterns (Figure 37). In $treatment_1$, the scores began at the high score (8) within the range, and ended at the low score, (6), whereas in the $treatment_2$ phase, the scores began at the low score and gradually increased up to the high score (8). Similarly, when analyzed visually, the data did not show change in performance as a result of treatment.

The high-stress skill (C) also showed an increased slope between $treatment_1$ and $treatment_2$. A negative slope (-0.20) was evident during $treatment_1$, which also marked the beginning of progression three of this skill. During $treatment_2$, the performance increased and plateaued at the same level as that at the beginning of $treatment_1$. The slight increase in level (5.8 to 6.5) indicated improved performance during $treatment_2$, as fewer low scores and one score above the highest scores in $treatment_2$ were seen. Thus, the trend of performance did show a very subtle increase from baseline through $treatment_2$ as seen in Figure 36.

A change in skill progressions for Skill I (the low-stress skill) towards the end of $treatment_1$ inflated the slope value for that phase. During $treatment_2$, there was a regression of scores toward the mean, the level of which was no different than that of $treatment_1$ (Table 26).

Skill D showed a flat slope with much variability during $treatment_1$. This variability was maintained during $treatment_2$, with a decrease towards the end of the phase, resulting in a negative slope of -0.03. However, the level change indicated improved performance along with the same degree of variability during $treatment_2$.

Although the level of performance on Skill E increased during $treatment_2$, there was no substantial change in performance from that of $treatment_1$. Neither the high-stress skill (C) nor the low-stress skill (I) showed improved performance, considering a change of skill progressions had just occurred at the beginning of $treatment_2$. Of the skills which did not

Table 26
Slopes, Ranges, and Levels of Performance Data
Subject 6

	Skills										
	A	F	B	G	C	H	D	I	E	J	
Baseline	.17	.33 -.17	.08	.00	.21	.08	.00	.00	.13	.04	
Treatment$_1$	.08	.04	.17	.00	-.20	-.08	-.04	.19	.00	.00	
Treatment$_2$	.06	-.03	.06	.00	.10	.21	.07	.05	-.03	.00	SLOPES
Post-treatment	.04	.07	.07	.07	.00	.44	.14	.21	.07	.00	

	A	F	B	G	C	H	D	I	E	J	
Baseline	4	3 2	2	0	4	4	5	3	2	2	
Treatment$_1$	4	4	4	0	5	2	4	2	4	3	
Treatment$_2$	6	3	3	0	6	4	3	5	5	6	RANGES
Post-treatment	3	3	3	1	5	4	4	4	5	5	

	A	F	B	G	C	H	D	I	E	J	
Baseline	5.4	7.4 4.9	4.8	1.0	6.6	5.9	6.7	5.8	2.6	2.5	
Treatment$_1$	6.7	5.3	7.1	1.0	8.0 5.8	7.3	6.6	6.6 6.0	3.7	3.4	
Treatment$_2$	4.7	5.4	6.6	1.0	6.5	7.0 5.2	6.7 3.9	6.7	4.4	3.2	LEVELS
Post-treatment	5.0	6.1	6.8	1.6	6.7	5.8 5.7	5.7	6.2	4.7	4.4	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

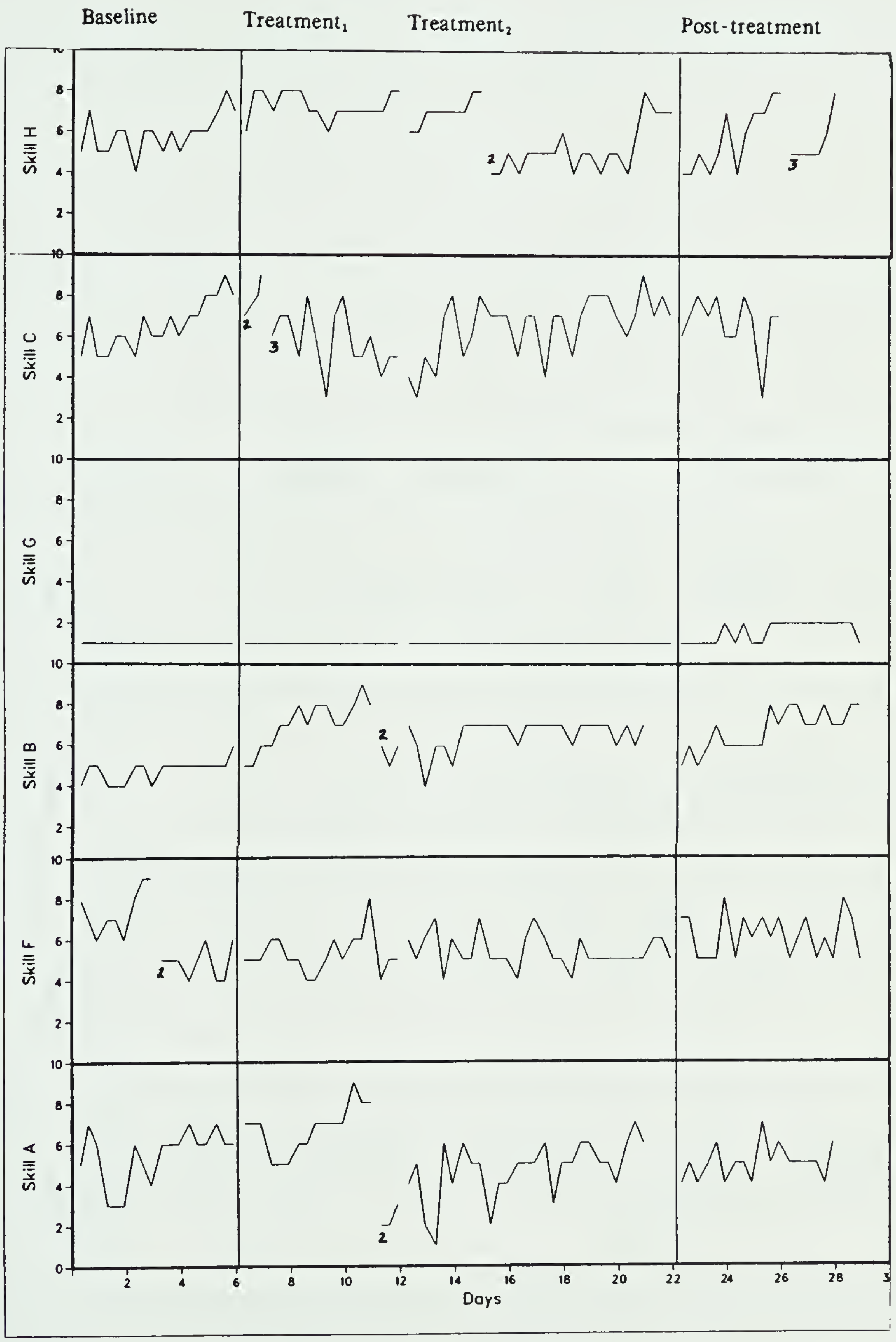

Figure 36. Performance Scores: Subject 6

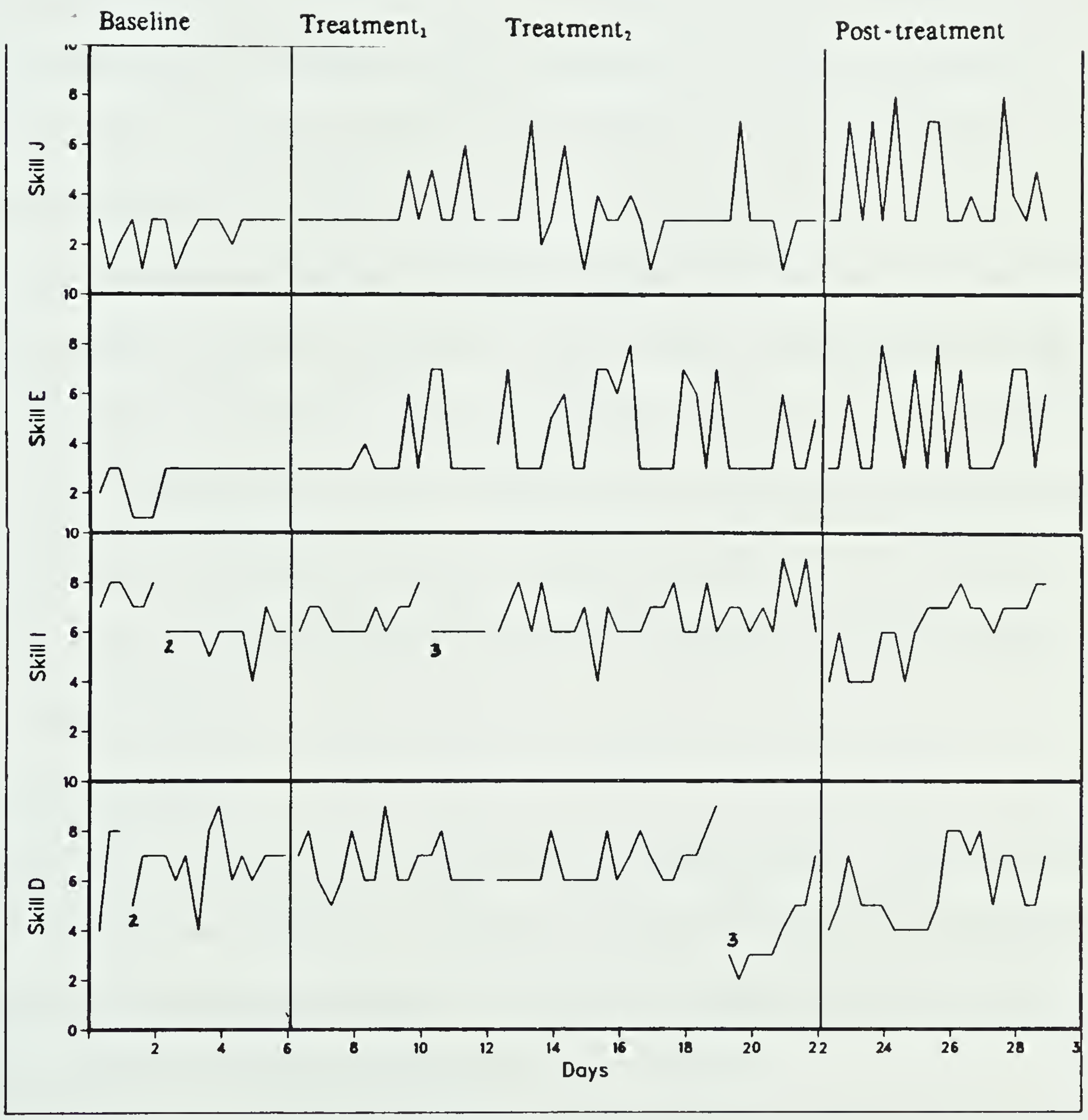

Figure 37. Performance Scores: Subject 6

evidence progression changes within the treatment phase, Skill C was the only one which according to Figure 36, showed a performance improvement. The difference between the levels at the beginning of $treatment_1$ and the end of $treatment_2$ were not different, suggesting that there was no actual improvement in the performance of Skill C.

Subject 7

Data for Subject 7 showed a slight increase of the post-test total stress ratings (Table 27, #2). Increased stress ratings were apparent for Skills A, F, G, and C, of which Skill C showed the largest increase from 14 to 28. This was the only skill that also increased when only the progressions she performed in the study were used in the calculation (Table 27, #3). She was the only subject who had achieved a performance level at progression 4 of this skill. This illustrates a case where the subject actually perceived more tenseness after attempting the skill. The increased stress rating of this skill at post-test time was supported by the subject's own feelings of stress, that she knew she was "physically prepared {but} was scared to death of the move". The two high-stress skills for Subject 7 (Skills A and H) showed similar findings. Skill A showed an increased stress rating over all the progressions, but a decrease when stress ratings of only the first two progressions were used (Table 27, #3). The overall stress rating of Skill H maintained at the relatively high level of 26. The low-stress skill (Skill F) increased in the overall rating, but showed no change when just considering the skill progressions she had performed (Table 27, #3).

Performance Skills

For Subject 7, Skills A, H, F, J, and B showed increased slopes in $treatment_2$ (Table 28). Skill A changed from a -0.08 to a +0.03 slope, showing a plateau of the performance at the mean level of $treatment_1$, accompanied by a decrease in variability seen in Figure 38. The drop in level verified the declining performance level in $treatment_2$.

Skill H, the high-stress skill, also showed an increase in slope (0.00 to +0.09) and a significant increase in variability. There was a large drop in performance during the first part

Table 27
Stress Ratings of Skill Progressions
Subject 7

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		2	2	3	3	4	3	5	4	3	3	
2. Total Stress Ratings	Pre	16	4	8	10	14	26	4	5	10	15	112
	Post	23	10	4	11	28	26	3	0	9	0	114
	Change	+7	+6	-4	+1	+14	0	-1	-5	-1	-15	
3. Total Stress Ratings of Progressions Performed	Pre	2	1	2	4	5	6	4	3	2	6	36
	Post	1	1	1	3	10	4	3	0	0	0	23
	Change	-1	0	-1	-1	+5	-2	-1	-3	-2	-6	
4. Pre-Test Stress Rankings		6	1	4	3	5	8	2	2	5	5	41

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

Table 28
Slopes, Ranges, and Levels of Performance Data
Subject 7

	Skills										
	A	F	B	G	C	H	D	I	E	J	
Baseline	.20	.10	.20	.30	.10	.00	.17	-.06	.00	-.10	
Treatment$_1$	-.08	.04	.04	.04	.08	.00	.17	.00	.00	-.04	
Treatment$_2$	.03	.10 .10	-.03	.00	.00	.09	.05	.00	-.03	.10 .20	SLOPES
Post-treatment	.50	.00	-.17	.00	---	---	---	.10	-.14	-.09	

	A	F	B	G	C	H	D	I	E	J	
Baseline	7	5	3	5	2	3	6	3	5	3	
Treatment$_1$	5	3	2	3	5	3	4	4	4	3	
Treatment$_2$	2	6 3	2	3	1	6	1	4	6	4 4	RANGES
Post-treatment	4	4	1	2	---	---	---	4	5	4	

	A	F	B	G	C	H	D	I	E	J	
Baseline	6.4	6.9	7.2	6.5	7.0	6.7	5.3	9.3	6.8	6.9	
Treatment$_1$	6.5	6.5	6.7	5.2	7.5	5.6	7.2 8.0	6.6	6.6	6.3	
Treatment$_2$	5.9	6.3 7.5	7.3	6.2	9.0 5.9	5.6	7.4	7.0	6.3	6.8 5.5	LEVELS
Post-treatment	5.8	7.1	7.7	7.1	---	---	---	6.9	6.4	5.0	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

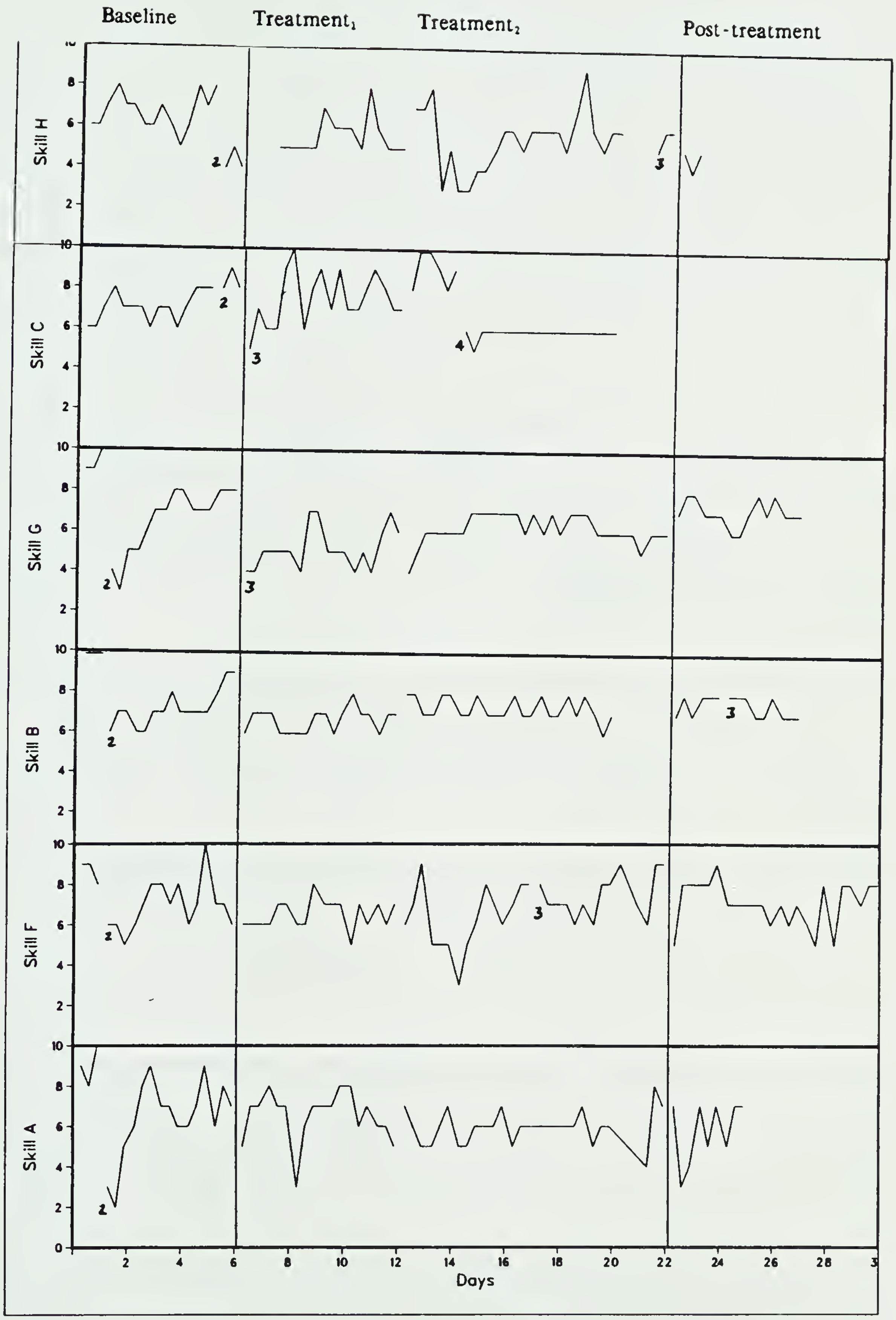

Figure 38. Performance Scores: Subject 7

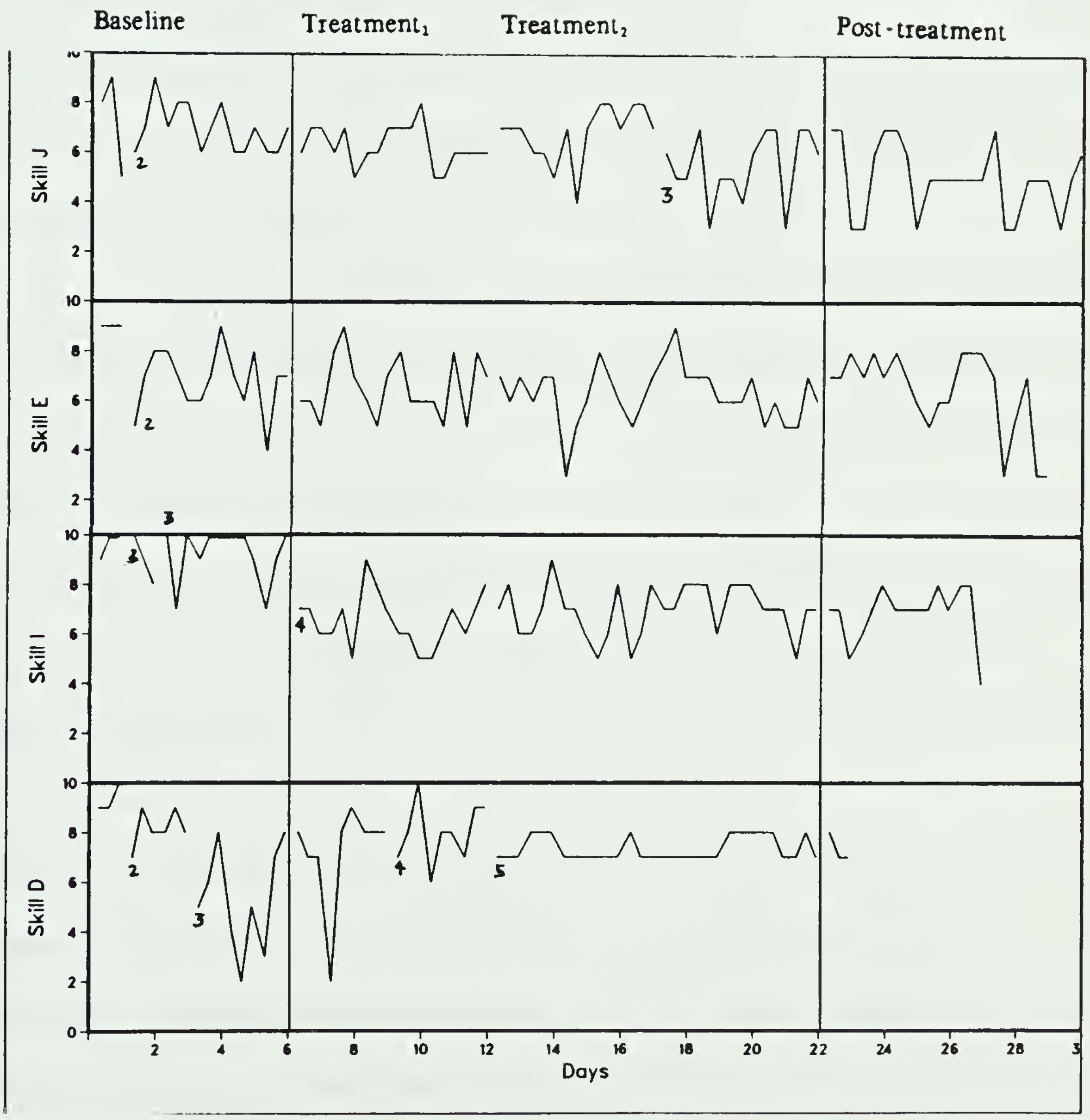

Figure 39. Performance Scores: Subject 7

of treatment$_2$, before climbing to criterion level and achieving a change to the next progression within Skill H. The lack of change in level was not representative of the rather large increase in variability of performance during treatment$_2$. Examining the data visually, there was not a steady increase in performance of this skill during treatment$_2$ when compared to treatment$_1$. Thus, as a modified-experimental or "control" subject, who did not receive the treatment, these results seem to add support to the hypothesized changes of the experimental subjects.

Skill F, the low-stress skill for Subject 7, showed a similar pattern to that of Skill H; a large drop in performance towards the beginning of treatment$_2$ was followed by a steady climb to the criterion level for progression change. There was a very slight change in level which was concealed by the large amount of variability during treatment$_2$.

The treatment slopes for Skill J also showed an increase from -0.04 in treatment$_1$ to +0.10 in treatment$_2$. This increase in slope was also accompanied by a slight increase in level, which did not verify a convincing performance change when analyzed visually (Figure 39).

A slight increase in slope of Skill G (-0.04 to 0.00) and an increase in level (5.2 to 6.2) combined to exhibit an improvement in performance during treatment$_2$ (Figure 38). The positive slope during treatment$_1$ plateaued at the upper range of treatment$_1$ and again showed an increase during the post-treatment phase.

Skill B showed a similar pattern during treatment$_2$. Performance plateaued at the upper level of the score range of treatment$_1$. One lower score at the end of treatment$_2$ contributed to a negative slope of -0.03. The increased range also supported the performance improvement (6.7 to 7.3).

Skills G and E showed negative slope changes. However, performance on Skill G showed a plateau effect during treatment$_2$, as evidenced by an increase in level (5.2 to 6.2). The beginning of a new skill progression also contributed to a greater slope during treatment$_1$. Even though the consistency of performance seemed to improve during treatment$_2$, it did not show improvement above the level of that in treatment$_1$.

The negative slope between $treatment_1$ and $treatment_2$ for Skill E reflected a decrease in performance evidenced by the level change from 6.6 to 6.3. The variability, rather large during both treatment phases, increased even more during $treatment_2$. Thus, no performance change was apparent in this skill.

Performance consistency of Subject 7 on Skills B and G seemed to improve during $treatment_2$. Although the high scores of the range did not increase in either skill, the range decreased by eliminating low scores. Skills H and F, the high- and low-stress skills showed no performance improvement.

Subject 8

The largest decrease in pre- to post-test stress ratings was evident in the data of Subject 8 (Figure 25). This was true when examining all progressions (Table 29, #2), as well as only those the subject had performed during the study (Table 29, #3). The high-stress skills (A, C, and H) showed substantial decreases in stress ratings of -8, -12, and -22, respectively. The low stress skills (F and G) marked the only skills that increased in perceived stress. This was possibly due to the frustration of being on one progression for a long period of time. For most skill progressions, the stress ratings by Subject 8 decreased whether or not she had actually performed them. This supports the fact that perhaps Subject 8 was inconsistent in her ratings on the pre-test, resulting in a slight inflation of her scores.

Performance Skills

Of the seven skills for Subject 8 that showed a positive change in slope between treatment phases, there were no convincing level increases to accompany them (Table 30). The most dramatic increase in slope was found in Skill D (-0.04 to +0.17). However, there was no change in variability and a very small increase in level. Although the skill was within range of the criterion level to change to the next progression, her performance lacked the consistency to warrant the progression change. Neither at the baseline-$treatment_1$, nor the $treatment_1$-$treatment_2$ phase changes was there any noticeable change in performance. A

Table 29
Stress Ratings of Skill Progressions
Subject 8

		Skill										
		A	F	B	G	C	H	D	I	E	J	Total
1. Highest Skill Progression Performed		2	2	2	1	3	2	3	3	2	1	
2. Total Stress Ratings	Pre	21	1	11	7	25	37	12	8	8	10	140
	Post	13	2	8	11	13	15	7	0	3	0	72
	Change	-8	+1	-3	+4	-12	-22	-5	-8	-5	-10	
3. Total Stress Ratings of Progressions Performed	Pre	2	0	0	0	4	9	4	2	0	0	21
	Post	1	0	0	0	1	0	3	0	0	0	5
	Change	-1	0	0	0	-3	-9	-1	-2	0	0	
4. Pre-Test Stress Rankings		7	1	6	3	7	8	4	4	4	4	48

* The maximum number of progressions per skill was 5, except for Skills C and H which each had 6.

Table 30
Slopes, Ranges, and Levels of Performance Data
Subject 8

	Skills										
	A	F	B	G	C	H	D	I	E	J	
Baseline	.20	.33	.25	.00	.44	.17	-.10	.20	.33	.00	
Treatment$_1$	-.08	.04	.13	-.04	-.04	.00	-.04	-.04	-.04	.00	
Treatment$_2$	.05	.08	.03	.00	.00	.07	.17 .06	-.03	.03	-.20	SLOPES
Post-treatment	.00	.09	.00	.06	.00	.03	.00	.09	.00 .13	.03	
	A	F	B	G	C	H	D	I	E	J	
Baseline	4	3	3	1	4	5	3	4	8	5	
Treatment$_1$	4	2	4	2	3	2	2	3	7	6	
Treatment$_2$	4	6	3	2	5	3	2 2	3	4	7	RANGES
Post-treatment	4	3	3	7	4	4	5	5	2 3	7	
	A	F	B	G	C	H	D	I	E	J	
Baseline	3.0	7.6 7.3	6.8 3.7	1.1	6.3 4.0	6.5	6.9	6.2	4.6	3.2	
Treatment$_1$	4.2	6.3	3.9	1.3	4.0	6.9	6.7	6.7	5.4	4.4	
Treatment$_2$	4.4	5.9	5.6	1.3	4.0	7.0 4.2	7.0 3.3	7.2	6.1	5.4	LEVELS
Post-treatment	4.7	5.8	6.0	3.4	4.6	4.9	3.9	6.2	6.4 4.1	5.7	

**Underlined scores refer to the end of one skill progression and the beginning of a new one during the next phase of the study.
Missing data has been designated by dashes (---).

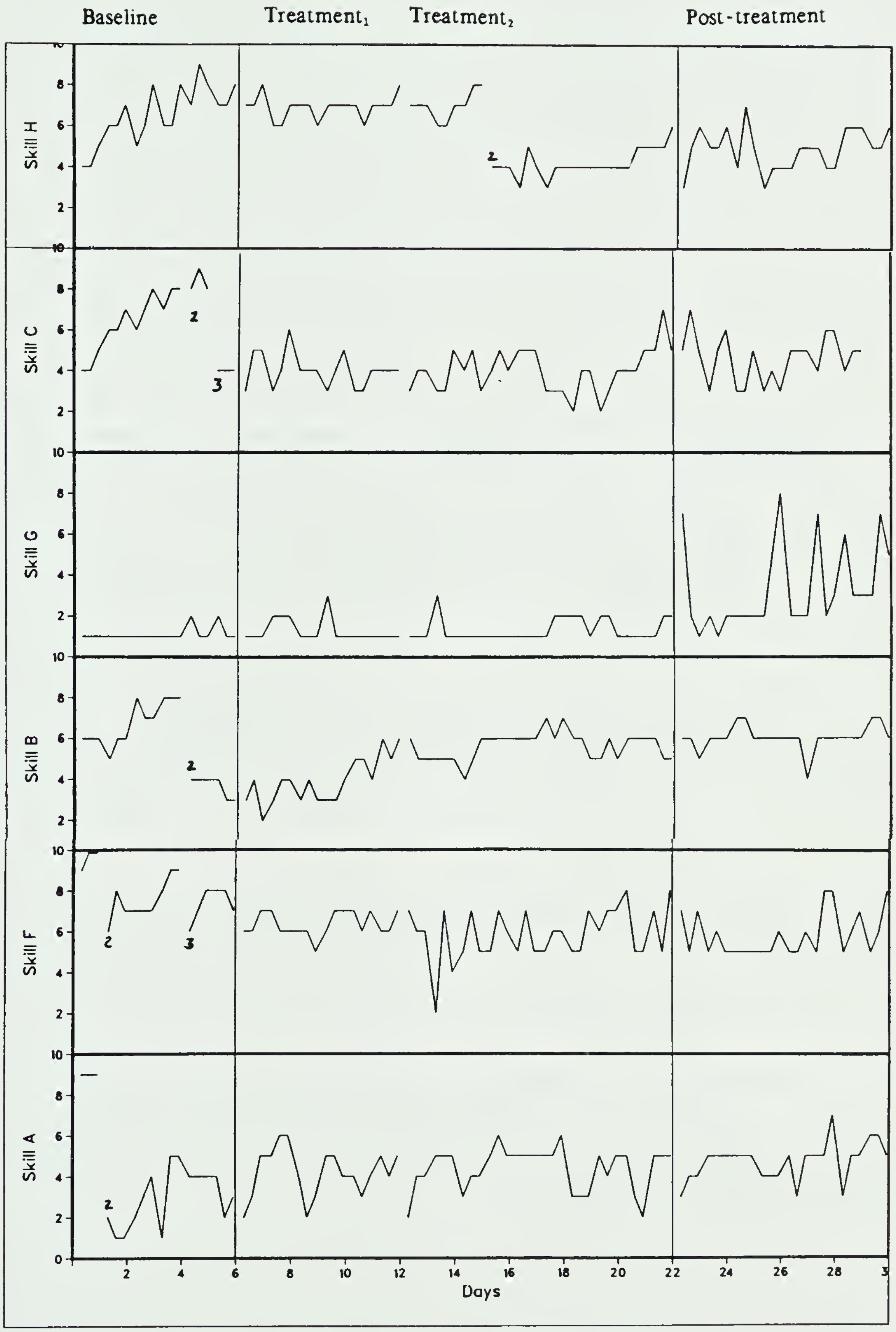

Figure 40. Performance Scores: Subject 8

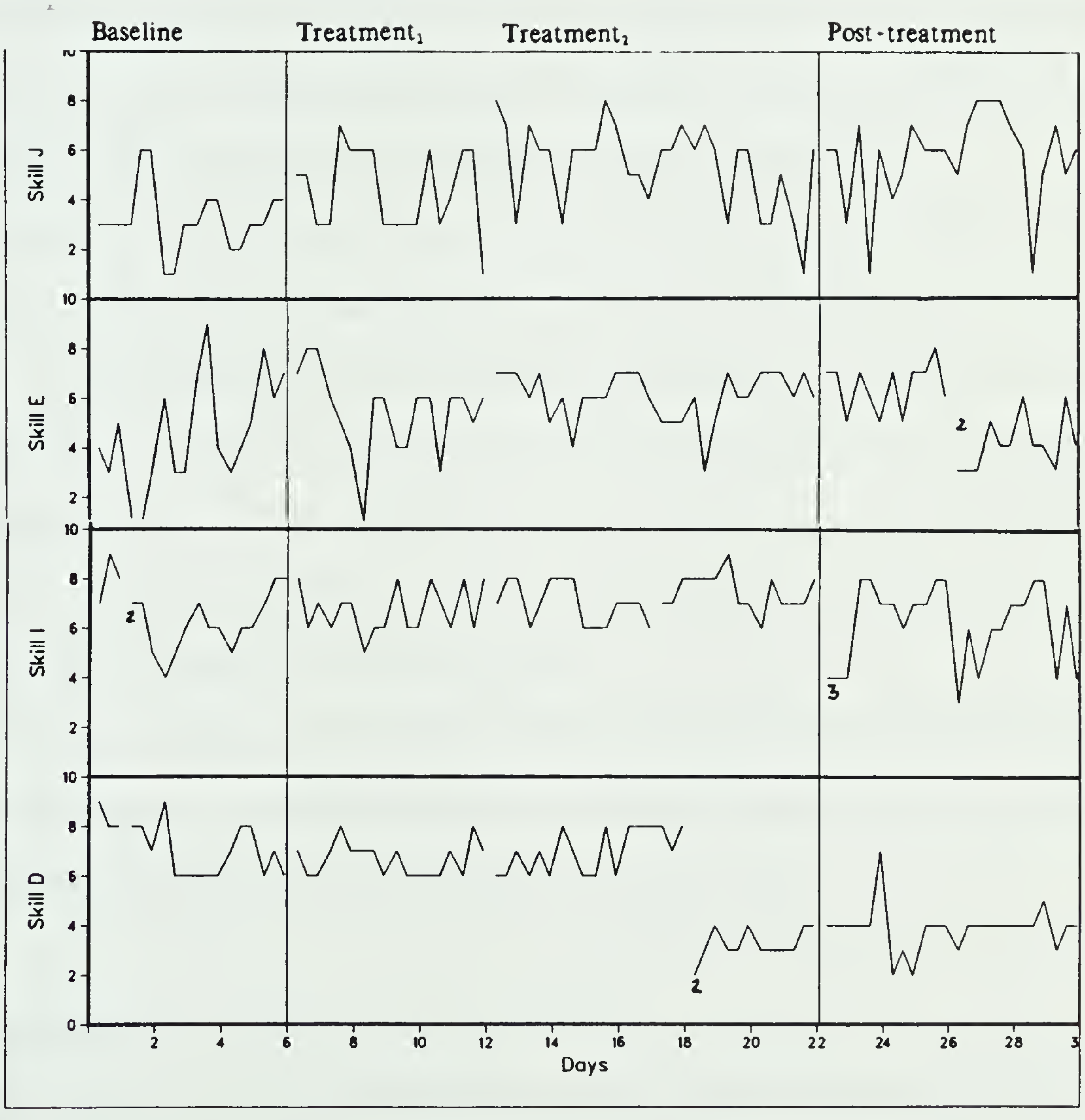

Figure 41. Performance Scores: Subject 8

similar pattern was apparent for Skill I, which showed slight negative slopes during both treatment phases, but lacked the consistency to maintain the high scores necessary to move to the next progression (Figure 41).

Skill H (high-stress skill) showed a steady performance during $treatment_1$ noted by a flat slope (0.00). Again, the performance seemed to be bordering on the criterion level. The level of performance at the end of the baseline phase was higher than that of the $treatment_1$ phase, signifying the subject's physical capability to reach such a level of performance, but lack of consistency to do so. The change in skill progressions shortly after the beginning of the $treatment_2$ phase, restricted the comparison of the two phases. However, of the limited data available, when visually examining the trend from baseline through the $treatment_2$ phase, there did not appear to be any substantial performance change at the beginning of $treatment_2$ (Figure 40). Generally, these results moderately support the predicted expectancies.

The low-stress skill, F, showed a slight increase in slope, a large increase in variability, and a slight decrease in level. A decrease in performance during the beginning of $treatment_2$ (Day 14), as well as two increased scores at the end of $treatment_2$ were responsible for the increase in variability. The level change was due to an increased number of the lower range scores during $treatment_2$. These results supplemented by the visual analysis of the graphed data supported the conclusion that these data did not show any increased performance change either at the onset of the $treatment_1$ or $treatment_2$ phases.

For Subject 8, data on Skill B showed a slight performance improvement, characterized by increased consistency of performance at a level attained at the end of $treatment_1$. No other evidence of performance improvement was found in the other skills.

C. Integrated Summary of Performance Data Analysis

Each subject was found to have individual patterns in her performance data, which were not consistent across skills or within the matched pairs of skills (A and F, B and G, C and H, D and I, E and J). Data for some skills showed trends that support the hypothesized

expectancies. However, these were not consistently found across skills within subject, and therefore did not produce a strong case in support of the expectancies.

To determine whether or not the unstressing treatment contributed to performance improvement over and above the effects of practice over time, the performance data for Subjects 4 and 5 were analyzed without a treatment delay, as if they were in E 1, with the treatment being administered at Week 7 instead of Week 13. In addition, the data of the experimental subjects (1-5) was compared to that of the modified-experimental subjects (6-8).

For Subject 4, Skill G showed a downward slope until Day 7, when an increase was noted which continued through Day 9 and then plateaued. This plateau was at the same level as that at the beginning of progression three (Day 4). Skill I also showed a performance improvement on Day 7. This showed a consistency at the highest level of the progression (Day 3). However, this level dropped on Day 9 and remained at the lower level through Day 18.

For Subject 5, Skills F and J were the only two skills that showed a slight performance change during Day 7. Skill F began an increase in performance at that time, which represented a return to a previous performance level exhibited at the beginning of the baseline phase (Days 1-3). Skill J on Day 7 reached a plateau at a higher level than previously. However, her performance remained at this level for the remainder of the study, showing no further improvement.

These data indicate that extraneous influences were not responsible for any significant performance changes that may have occurred in the data of Subjects 1, 2, and 3 during treatment_1. This analysis does not, however, account for the individual's rate of performance change during repeated practice of the same skills.

The first comparison of experimental to modified-experimental subjects examined the number of skills for each subject which showed some support for performance improvement during the treatment_2 phase. These skills are listed in Table 31. With the exception of Subject 3, all experimental subjects showed improvement on more skills than the modified-experimental subjects. This difference between the experimental and

Table 31
Skills Showing Performance Improvement during the Treatment$_2$ Phase

	Experimental					Modified-Experimental		
Subject	1	2	3	4	5	6	7	8
Skill	B	D	B	A	C	E	B	B
	E	E	E	E	F		G	
	H	J		I	H			
				J				
Total	3	3	2	4	3	1	2	1

Table 32
Skills in Treatment$_2$ Showing Decreases in Performance Below the Low Level of Treatment$_1$

	SUBJECTS							
	Experimental					Modified Experimental		
	1	2	3	4	5	6	7	8
Skill (Level Change)	B (+1.2)	F (+0.2)	A (-0.3)	---	---	J (-0.2)	E (-0.3)	F (-0.4)
	H (+0.6)		B 0				F (-0.2)	C 0
			D (-0.3)				J (+0.5)	
			J (-0.5)					

modified-experimental subjects contributes to the support of the expected affect of the unstressing treatment on performance of some skills. All except one of the skills in Table 31 were categorized in the middle of the ten-point stress scale by the subjects. The only skill showing improvement that was classified as a high-stress skill was Skill H for Subject 5. From these data, several conclusions were drawn. First, the total number of performance improvements for each experimental subject outweighed those of the modified-experimental subjects, indicating that the unstressing treatment may have had a subtle but positive affect on performance.

Second, within the skills that showed performance improvement, there did not seem to be commonalities that would explain why these particular skills showed improvement and others did not. The indirect relationship between the treatment and performance that existed in this study, prohibits anything other than speculative explanations for these findings. Perhaps, the treatment affected performance on each skill at different lag times after it was introduced to the subject. These data provided evidence of this possibility, which may or may not have been due to the affect of the treatment as opposed to the affect of practice or the combination of both. Another possible explanation is that this particular treatment may have been applied to each skill at different intensity levels, depending on the subject's perception of the technical requirements of the skill. (i.e. The subject may not have felt the need for a stress management technique such as unstressing to be applied to a skill perceived to be of lower skill difficulty.)

Third, there were fewer subjects who showed low peaks of performance during treatment$_2$ below the low peaks of the treatment$_1$ phase. Table 32 shows that Subject 3 was the only experimental subject to show decreased performance scores that were accompanied by slight decreased level during the treatment$_2$ phase. It is speculated that these performance decreases were caused by the frustration of remaining at the same progressive stage for a longer period of time than the subject perceived she should. Although Subjects 1 and 2 showed at least one decreased score during treatment$_2$, the level of performance during this phase was

shown to be higher than that of $treatment_1$ indicating an overall increase in performance.

The same analysis for the modified-experimental subjects showed that all three subjects showed an example of a skill that decreased during $treatment_2$ below the low level of $treatment_1$. These skills were all accompanied by decreases in level with the exception of Skill C for Subject 8 which showed no change in level, and Skill J for Subject 7 which showed a slight increase in level. These data suggest that perhaps one of the subtle and yet important effects of the unstressing treatment on the experimental subjects was to decrease the variability caused by decreases in performance. That is, the treatment may have affected the low range of the performance scores, keeping it stable or increasing it.

D. Further Analysis from the Post-Research Questionnaire

Beyond the results of the physiological and performance data, there were several indirect findings noted from the post-research questionnaire. The questions were purposely stated very succinctly and without much detail, so as not to predefine the types of comments made by the subjects. Accordingly, the responses were of varied lengths and content. With the exception of Subject 5, who did not see much need for the treatment, the experimental subjects commented rather extensively about their experience with the unstressing treatment in settings other than the laboratory.

Throughout their responses, the development of confidence in themselves was prominent. One of the experimental subjects advocated that "the training helped {her} to develop confidence when working under many different sets of expectations (student teaching). Just the idea that *I am in control* prompts initiative and then perserverance". Another subject "developed that *inner confidence*...{becoming} more keenly aware of shoulder tension and breathing patterns and the way that I can control both of them in order to remain relaxed when necessary". These subjects carried over this development of self-confidence to the performance setting. Comments with regard to the combination of "the consistency of the practice {performance} setting with the added confidence from the *I am in control* assertion"

alludes to the transfer of the unstressing training to the performance setting. For one subject, peer pressure encouraged her to develop and apply the unstressing training in the performance setting. "I did not think I would ever be able to do a lot of the moves -- or just be too scared to 'go for' them. But with everyone being in the same boat that I was, and being *in control*, I overcame my fear". Particularly on skills appraised by the subject as being stressful, for whatever reason, these subjects seemed to apply the unstressing training in an attempt to reduce the person-environment misfit they were experiencing. "I was able to use {*I am in control*} in order to collect my guts and my wits and 'go for' {the skills}.

The experimental subjects also developed an awareness of the tension levels throughout their bodies. "I started to notice if my shoulders or brow were tight which previously I had never felt...I was able to totally relax that part". This was expressed not as awareness of a total feeling of tension, but of specific areas of the body, different to each individual. "I have become very much aware of the tensions my body carries in every day life. I have learned to zero in on these areas and make sure they are relaxed." These changes and awarenesses that were recognized were not always of a conscious nature. "Without thinking, I found I was breathing through my stomach rather than my chest".

A problem that was in the forefront while planning and beginning the data collection was how to deal with the skepticism of the subjects with regard to the usefulness and validity of the relaxation training. The subjects subtly stated that since they had never been exposed to this type of training, and therefore the concept was a new one to them, they were not sure at the beginning of the testing how to react to it. As one subject put it, "it is something that has to be <u>learned</u> by people because it is not a habitual part of our lifestyles". For some of the subjects, the application of the training to other aspects of their lives was immediately recognized. For Subject 5, in particular, she evidently saw no immediate need for the training and therefore did not make a conscious effort to apply it outside of the laboratory.

The protocol of the performance sessions was also seen as a benefit to the experimental subjects. "Having a set criterion at each progression and meeting those criteria in order to

proceed...that kind of consistency in learning and practicing is so helpful in skill acquisition and relief of accompanying tension...I was surprised that by constant practice you actually do learn". Mention of frustration during the skill performances was common among all the subjects, as well as being a typical emotion felt by most athletes in learning and performance situations. The importance of the athlete's perception of where she fit into the performance situation was expressed by one of the experimental subjects. "When I was doing well, and progressing, the {performance} sessions were great -- when I was injured they were frustrating, and when I was getting nowhere and not learning how to do the skill it was both frustrating and depressing".

The modified-experimental subjects also commented on the benefit they gained from the performance sessions. The progressions helped one subject "in getting over the fear of doing some of the more difficult moves". Gymnastics requires a great deal of kinesthetic awareness and timing which can only be developed through repetitions of skills with a constant awareness of body position and coordination of movement. One subject commented that the repetitions "allowed the person to experiment with the skill and figure out what way worked best for each individual". Thus, individual differences are also emphasized within the techniques of skill performance that are most effective for each athlete.

There was a degree of motivation and confidence derived from the progressive method of performance "in the fact that we all wanted to do well and progress -- at least at the same rate as the others". This development of confidence was often found to be accompanied by the frustration also alluded to by the experimental subjects. "Skill repetition increased my confidence with the move I was working on, but also served to frustrate me on moves I felt I should have mastered earlier or if my performance decreased".

These responses from the subjects add to the total picture of the athlete and her environment. Her perceptions of the situation, both during the study and after its completion, shed light on some of the unexplained physiological, psychological, and behavioral responses. The intricate interrelationship among these components was different for each subject. In all

cases, each of them was emphasized and weighted according to the situational factors as well as her perception of the situation.

These findings support the components and application of Marten's Theory of Competitive Stress. The *objective competitive situation* was comprised of the unstressing tapes and the skill progressions. The subject's perception of these situations (*subjective competitive situation*) was seen to have great impact on her physiological, psychological, and behavioral *responses*. Her preference or dislike for a particular unstressing tape often influenced her physiological and psychological responses. Her perception of other thoughts on her mind (e.g. exams or being extremely busy) was also seen to influence her responses. Her perception of her level of skill performance with reference to herself and her peers, as well as her performance on any given day, influenced her emotional perception of the performance situation. This perception was seen to determine whether she felt confident, with a sense of achievement and motivation, or frustrated with her lack of constant improvement. The *consequences* of her performance influenced her reappraisal of the situation.

This feedback loop associated with Marten's theory helps to explain the inconsistency in the physiological, psychological and behavioral responses across time seen for each subject. Although the unstressing training was not directly linked to the performance aspect in this study, the interrelationship between physiological, psychological and behavioral components implies that they did influence each other. The intricacy of their interrelationship precludes the researcher from measuring precisely how much impact the unstressing training had on these three components for each subject in this study.

VI. SYNTHESIS, IMPLICATIONS, AND RECOMMENDATIONS

A. Introduction

It was the purpose of this study to examine the physiological and psychological effects of a modified form of progressive relaxation training on the performance of gymnastic skills. The unique design, a case study using simple time-series data, emphasized the individual differences of each subject. Self-report data allowed further insights to be made with respect to the various patterns within the data.

B. Synthesis of Physiological and Performance Analyses

The physiological and performance data were separately analyzed within each subject. Each individual displayed unique data patterns, which resulted in no obvious conclusions applicable across all subjects. However, these individual response patterns, in conjunction with self-report and observational notes kept by the researcher, were formulated in light of the research questions into a synthesis of the results for each individual.

Subject 1

Within the laboratory sessions, Subject 1 appeared to respond physiologically and psychologically to her level of electrodermal activity. Examining her responses over the entire fifteen weeks, her muscle tension showed a decreasing trend both in mean level and in reduced intersession variability. Although there was no statistical significance found, these data suggest that a treatment effect may have occurred both within the laboratory and as an application to her general level of muscle tension. Her perception of the stress ratings of the gymnastic skill progressions seemed to also be positively affected by the treatment, indicated by an overall reduction in the SARP score. It was also shown by the individual skill ratings that merely executing a skill several times initiated a decrease in her perception of its stressfulness. The

treatment was specifically used by Subject 1 prior to her performance of Skill C. When comparing this high-stress skill, C, to the low-stress skill, D, there was an obvious performance difference. Skill C showed constant improvement with Skill D being the only skill that showed a decrease in performance during treatment.

Subject 1 demonstrated that she was not one who is "quick to jump on the band wagon" unless she feels there is just reason to do so. Once she was convinced of the usefulness of the treatment to her performance, but more importantly as a positive influence on her lifestyle, there was a positive influence on her perceptions of stressful situations and her ability to better cope with them, as indicated by her performance data on Skill C.

Subject 2

Subject 2 showed her ability to decrease her muscle tension over the course of the study, even though her baseline EMG measurements were very low to begin with. She seemed to be a gymnast who was eager to progress in skill level as well as please her coach by abiding by the coach's instructions. This attitude persisted until progress slowed down for whatever reason. Then frustration had a negative influence on her responses. Being eager to please and having a low level of muscle tension to start with, the data suggested that she may have been trying too hard to get positive results in the treatment sessions. This counteractively resulted in slightly increased muscle tension. These dysponetic tendencies may be justification for her carry-over of this attitude into the performance sessions. The skills which showed an increased stress rating at post-test (Skills F and H) showed no performance improvement. Similarly, Skills B, C, and D showed a substantial decrease in her stress level ratings and showed positive performance changes. Although data were limited for Skill C (the high-stress skill), there were modest showings of improvement, as opposed to the low-stress skill (Skill I) which showed a decrease in performance. Frustration on the less stressful skill progressions seemed to negatively influence this individual's performance.

Subject 3

Subject 3 demonstrated a consistent decreased level of muscle tension within treatment sessions. Her ability to recognize her stress level seemed to correlate fairly well with her level of trapezius muscle tension. Across time her muscle tension significantly decreased from baseline through post-treatment.

As mentioned previously, Subject 3 personified a mildly hyperactive "busy" young lady who was strong-minded. This was a trait that benefited her in working toward achievement of her goals as long as the pace of her progress was not impeded. Frustration was commonly observed in the performance testing sessions for Subject 3. Skill E was the only one that showed a substantial performance improvement, and yet it increased in its rating of stressfulness to Subject 3. Several of the skills showed positive, yet not powerful, changes in the rate of performance within the treatment phase. There was a difference between the stress ratings of the high-stress and low-stress skills. Skill C (high-stress) showed a performance improvement, while Skill J (low-stress) showed a definite decline. For a skill rated low in stress by this subject, she perceived herself to potentially be able to progress faster than she did, causing frustration and a subsequent performance decline. Skill B showed a similar trend. In these cases, a strong will emphasized her frustration, declining performance and increased perceived stressfulness of the skill.

Subject 4

Subject 4 was the only subject who showed several instances, during which all three physiological variables reacted in their expected direction of the "relaxation response". All three physiological variables showed convincing data that suggests she was positively affected by the treatment within sessions. Her muscle tension level decreased and became less variable after she adjusted to the treatment. Her electrodermal activity also showed a reduction over time. It did, however, seem to be of a more responsive nature than EMG, showing slight increases on the first day of each new tape within the treatment. Although her peripheral

temperature actually showed a decline over the course of the study, there was convincing evidence of increases caused by the unstressing treatment. Subject 4 could be depicted as an intense and efficient person, who required that her performances were close to perfection. Being a rather quiet person, who kept her feelings to herself, her EMG data revealed her mean level as one of the highest of any of the subjects. Subject 4 showed the largest decrease in overall stress ratings from pre-test to post-test. The high-stress skill, H, showed a decrease in post-test but no noticeable change in performance level. The low-stress skill responded with an increase in post-test stress ranking and no performance gain. Thus, for Subject 4, there did not seem to be any difference between skills ranked at the extremes of the stress scale. The moderately ranked skills showed the most performance improvement. There does not seem to be evidence from these data sources that Subject 4 was able to effectively use the unstressing treatment she received to effect a performance improvement.

Subject 5

A significant increase in level of peripheral temperature was the only evidence of any treatment effect for Subject 5. This may have been a direct result of the subject's negative attitude toward the usefulness of the treatment. The skill level of this subject restricted her from showing convincing performance increases. The skills which showed increased stress ratings were those of the uneven parallel bars, her least favorite event. There was a difference between the performance trends of the high-stress (H) and low-stress skills (I). Skill H showed an obvious performance improvement, while Skill I showed no change. Due to her skill level, and the lack of maintenance of the improved performance level, it is hypothesized that the effects of skill repetition influenced her performance improvement on Skill H.

Subject 6

The physiological measurements for "control" Subject 6 showed variability throughout the study, especially that of electrodermal activity. None of the variables showed trends in a

direction consistent with the "relaxation response". Her stress ratings of skills decreased overall, and within each skill for the progressions she had performed. This again suggests that stress levels are decreased merely by performing the skill. Even though the high-stress skills (C and H) showed a decrease in perceived stress, there was no substantial increase in the level of performance of these skills. Subject 6 has a need to perform well and did not seem to hold back or procrastinate when attempting a new progression. This sense of 'vertigo' was represented in the high variability of her physiological measurements. As well, in the low-stress skill, Skill J[23], there was an increase in variability of performance and a slight decrease in mean level, indicating no performance increase.

Subject 7

"Control" Subject 7 showed some physiological responses that would be considered a "stress response". Her EDA measurements coincided with stressful school events (e.g. exams). There was considerable variability in her physiological measurements, particularly temperature. She was categorized as a talented and very coachable athlete, willing to try almost anything. Her personality exuded a positive attitude that allowed her to put forth a concerted effort to do her best. This attitude did not show up in her physiological data, even though she may have responded with a placebo effect from being a subject in this study. Her stress ratings of skills increased slightly from pre-test to post-test. Her response on Skill C indicates that on skills that are highly stressful to her, it took more than just experiencing the feeling of doing the skill to reduce the stress level. The high- and low-stress skills could not be evaluated due to progression changes. However, Skills B and G were the only ones which suggested a performance improvement.

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[23]There was a change in progression of the low-stress skill (I), which precluded evaluating its change in performance.

Subject 8

In her EMG measurements, "control" Subject 8 responded according to the "relaxation response", revealing a decrease in muscle tension across time. Subject 8 can be characterized as a very stable individual, who never seemed to let problems bother her. This attitude seemed to carry over into her control of her level of muscle tension during this study. Her overall stress ratings of the skills revealed a substantial decrease at post-test time. Her high-stress skill (H) decreased and her low-stress skill (F) increased, a pattern similar to some of the experimental subjects. However, her performance responses did not reveal any substantial improvements. On several skills, she remained at the criterion level for a period of time, unable to perform with enough consistency to progress.

Summary

The collation of all the data collected in this study reveals one common theme across all subjects. This seems to be the critical implication of this piece of research. Regardless of what the treatment is or what methodological procedures are used, it is the subject's perception of the situation that is a major influence on the physiological, psychological, and behavioral responses to that particular situation.

C. Discussion of Results

There were several assumptions made regarding areas of the methodology used in this study. In addition, the results and analyses of the data revealed issues that are important considerations for the reader to be aware of.

Underlying the use of an unstressing technique as the treatment is the assumption that the unstressing treatment was appropriate for all of the subjects. Some subjects may have found a different treatment to be more applicable to their needs. Another assumption was that each of the experimental subjects had a need to only decrease her level of arousal. There may have times during the study when the athlete actually needed to use a technique to increase her arousal level. The inconclusive results within subjects may have been a result of this concern.

By introducing the athlete to biofeedback procedures, she would be able to learn to bidirectionally control her level of arousal.

The subjects in this study were in a sitting position during treatment. This position was chosen for this study to decrease the adaptation process when using the treatment procedure outside the laboratory setting. However, most studies employing progressive relaxation training implement it to the subjects in a reclining position. The physiological results of this study cannot therefore be compared to those of other studies unless the methodological procedures are comparable.

A similar concern refers to the duration of the treatment within and across sessions. In this study, the unstressing treatment consisted of a ten-minute cassette tape. One consideration is whether or not ten minutes per session is long enough for the subject to accomplish the goals of the tape. In a long-term sense, a primary concern is whether or not the subject learns the skill of unstressing at all. Secondly, if the subject is able to develop the skill, how many days, weeks or months will it take? These are concerns that the reader should be aware of and future research will hopefully resolve.

A final consideration when examining the results of this study concerns the link between the objective and subjective data. Although there was little statistical significance found in these data, speculative implications were noted based on the subjective data. Since our understanding of the intricate pathways among cognitive, physiological, and behavioral variables is at the present time in the beginning stages, observation of the interrelationship in field settings furthers our data base in this area of research.

D. Coaching Implications

The analysis and interpretation of these data using a case study design touched on many of the idiosyncracies and unique occurrences within the coaches' daily communication with their athletes. These results encourage coaches to make a concerted effort in their understanding of each athlete and acceptance of her idiosyncracies. The way the athlete

perceives each situation, whether it be practicing or competing, is unique to that individual. Her physiological and behavioral responses to these situations also reflect her individuality. Coaches are in a position to alter the athlete's perceptions through changing the situational components, and/or providing the athlete with an opporturnity to develop her emotional control by applying a stress management technique such as progressive relaxation. To be effective and transferable to the gymnasium, the use of such a technique must be understood by the coach and especially the athlete. A large part of its effectiveness depends upon the athlete's perception of whether or not it will help her, and if so, how and to what extent.

The results of the performance data in this study revealed little conclusive evidence that the athletes' skill performance was affected by the unstressing technique, because there was no direct link between the treatment and performance. However, there was strong evidence that the athletes benefited psychologically, by developing their self-confidence and motivation when they would have otherwise given up due to fear or frustration. In the long run, the development of these skills seems to increase the athlete's intrinsic motivation, the importance of which cannot be underestimated in athletes.

There is also evidence that merely paying attention to the athlete and showing interest in her as an individual, in a very important aspect of her life produces beneficial results. In team sports, there is a greater possibility that the coach may treat the athletes as a team, not as individuals. In both team and individual sports, increased individual communication can determine what situations are stressful to each athlete and in what way, and how the reponses to these situations can be reevaluated to benefit the individual as a team member.

Inevitably, the athlete will face the frustration of not progressing as quickly as she thinks she should during the learning stages of a skill. The interest must be taken in the athlete to help her understand her response pattern, and gain the emotional control to effectively deal with these frustrations that are inevitable in skill development. The results of this study suggest that observing a reduction in the frequency of poor performance may indicate the first stage of performance improvement, after which the good performances increase in frequency.

The communication of this to the athlete can help to change her perception of her performance level.

Athletes are not only individualistic in their perceptions, but also in their behavioral responses. The trends and patterns of skill performance were varied within individuals. The athlete perceived her own level of performance in relation to the standard she had set for herself. This greatly influenced her attitude during performance and consequently her actual skill performance. Therefore, consistent and optimal performance is not dependent solely on physical capability, but also on the athlete's perception of whether she thinks she can perform the skill, and allowing herself the time to develop the coordination and timing necessary for the optimal performance of the skill.

Overall, the coachs' concerted efforts to understand their athletes as individuals, accept their idiosyncratic responses, and provide the opportunity for them to develop their emotional control can all be beneficial to the individuals as well as to their athletic performances. Coaching is the "art" of being able to effectively communicate with the athlete to solve her individual problems, that she perceives to be important in an athletic performance situation.

E. Recommendations for Future Research

The following recommendations were made for future research that deals with the physiological, psychological, and behavioral components of the athlete.

1. The case study design needs to be more widely used to develop a better understanding of the interrelationship among these components within the individual. Within this design,employing a time lag of treatment while observing several athletes simultaneously, allows the emphasis to be placed on individual differences while controlling for the threat to internal validity from a history effect.

2. Applying modified progressive relaxation to male athletes as well as athletes of other sports will develop the generalization of these results.

3. Data on the use of other stress management techniques with athletes will determine

which techniques are better for which type of athletes.

4. The direct link between the treatment and performance in a field setting needs to be examined. Using extensive self-reports or radio telemetry, the "realness" of the experimental setting, and the athlete's perceptions can be evaluated.

5. Self-reports reveal valuable information that may account for idiosyncracies in the data. Those idiosyncracies need to be better understood, in lieu of treating them as exceptions to a general pattern. They may represent an emotional response that can contribute to a better understanding of the interrelated responses of the athlete.

6. Since it has been shown that the athlete's perception of the situation has a tremendous impact on behavioral responses to that situation, future research needs to be directed toward developing a theoretical model to understand the relationship between cognitive variables and behavioral response. In particular, an understanding of the subject's cognitive coping process in various situations may be significantly related to behavioral responses.

7. Further research in examining the athlete's development of emotional control through biofeedback needs to be examined. There is a need for the athlete to be able to recognize the intensity of her tension level. Further, there is a need for her to be able to control her level of arousal, raising or lowering it according to the situational demands. The response systems may show different interrelationships when the athlete is provided feedback.

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APPENDIX A

Experimental Design

EXPERIMENTAL DESIGN

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Experimental Group 1 (E 1) N=3	Baseline			Treatment								Post-treatment			
				Tape 1		Tape 2		Tape 3		Tape 4					
Experimental Group 2 (E 2) N=2	Baseline						Treatment								Post-trt
							Tape 1		Tape 2		Tape 3		Tape 4		
Modified Experimental Group 3 (ME) N=3	Baseline														

Within each daily treatment session:

Pre-Training Measurements .... Treatment (Tapes 1 - 4) .... Post-Training Measurements

Experimental Procedures

Time	Exp. Grp.	Procedures
Pre-Testing	All	Administer Pre-Test SARP
Weeks 1-3	All	*Baseline Procedures:* a) Physiological Stabilization b) Five minute Baseline Physiological Testing (EMG, EDA, TEMP) {Pre-Training} c) Performance Testing: 2x/week in gymnasium
Weeks 4-15	E 3	Continue Baseline Procedures (Physiological and Performance Testing)
Weeks 4-5 Weeks 7-8	E 1 E 2	*Treatment Procedures:* a) Physiological Stabilization b) Five minute Pre-Training Physiological Measurements (EMG, EDA, TEMP) c) Tape 1 - Unstressing Treatment (10 minutes) d) Five minute Post-Training Physiological Measurements (EMG, EDA, TEMP) e) Unstressing Home Training - 1x/day f) Daily completion of RUS before and after Treatment g) Performance Testing: 2x/week in gymnasium
Weeks 6-7 Weeks 9-10	E 1 E 2	Treatment Procedures using Tape 2
Weeks 8-9 Weeks 11-12	E 1 E 2	Treatment Procedures using Tape 3
Weeks 10-11 Weeks 13-14	E 1 E 2	Treatment Procedures using Tape 4
Weeks 12-15 Week 15	E 1 E 2	Baseline Procedures
Post-Testing	All	a) Post-Test SARP b) Post-Research Questionnaire

APPENDIX B

Scripts of Relaxation Tapes

TAPE 1

Shift to a comfortable position. Be sure your belt is loose, your shoulders are loose, your legs uncrossed, your glasses off. Close your eyes. Clench your right fist...tighter and tighter. Be sure you continue to breathe, allowing the lips to be slightly parted.
Exhale through the mouth, whispering HA. Be sure the rest of the body is relaxed. Observe the sensations of tightening.
Now let go and relax...Observe the contrast in feeling between your right fist tensed and relaxed. Observe the difference in the way your right and left hands feel now.
Now tighten your left fist...Observe the sensations of tightening. Be sure you keep breathing, and that the rest of the body is relaxed. Now let go. Observe the sensation and feeling of letting go...If your attention wanders to other things, gently bring it back to the sensations in your arm.
Now tighten both fists. Observe the sensation of tightening... Then let go and relax all over. Enjoy the sensation...
Now bend the elbows. Tense both biceps (in the front of your upper arms). Let your hands and fingers be relaxed. Observe the sensations of tightening...
Keep breathing. Be sure your neck, your jaw, and the rest of your body are relaxed.
Now relax and let your arms drop either to your side or to your lap. Notice the difference in feeling between tensing and letting go.
Straighten your arms so that you tense your tricep muscles (in the back of your upper arms), again keeping your hands relaxed. Keep breathing smoothly...Observe the sensations of tightening. Relax your arms at your sides or on your lap. Relax all over...
Notice that your arms feel comfortable and heavy. Feel the relaxation spread up your arms. Notice that your arms feel heavier and heavier as you relax more and more.
Frown hard...Be sure the rest of your body is relaxed. Relax and let go...Now wrinkle your eyebrows up toward your scalp. Be sure your tongue, jaw and neck are loose and you are not holding your breath...Observe the sensation of tightening. Relax and let your brow be smooth. Observe the sensations of relaxation...
Now tighten your eyes. Tighten the muscles deep in your eyes as well as the facial muscles around your eyes. Be sure your tongue, your jaw, the back of your neck and the rest of your body are relaxed...Relax and keep your eyes gently closed...Observe the sensations of relaxation and how they differ from those of tightening.
Clench your jaw and clench your teeth. Study the tension in the jaw. Be sure you keep breathing...Relax and let go...Slightly part your lips and as you exhale, let the air go out your mouth in a soft whispered HA.
Press your tongue hard against the roof of your mouth. Observe the tension...Relax and let go. Feel the relaxation in your cheeks, scalp, eyes, face, arms, hands...
Now tighten your neck by tilting your head backwards. Be sure you keep breathing and the rest of the body stays relaxed. Feel the tension in your neck...Relax and let go.
Breathe comfortably and let your jaw be relaxed. Bring your head forward toward your chest. Feel the tension in your neck. Relax and let go...
Raise your shoulders to your ears. Be sure the neck and the rest of your body are relaxed. Notice the contrast between how your shoulders feel and how the rest of your body feels...Relax and let go...
Let the relaxation flow into your back, neck, throat, jaw, and face. Let it spread and go deeper and deeper...Feel the force of gravity pulling on your body...
Breathe deeply and hold your breath. Note the tension in your chest and shoulders. Be sure your eyes, your jaw and the rest of your body are relaxed. Exhale and observe the feelings.
Breathe in and out normally. Notice how on each exhalation you feel more and more relaxed. Let the chest walls be loose and soft as you breathe out...
Now take another deep breath. Hold your breath. Be sure the neck is relaxed. Exhale. Feel the release of tension. Let the relaxation spread to your shoulders, neck, back, and arms...
Tighten your stomach as if you were receiving a blow there. Make it solid...Relax and notice

the well-being that accompanies your relaxation...
Now suck your stomach in. Hold it...Relax and let go. Let your breathing go smoothly and easily. Note that you can feel the whold lower abdomen move out as you inhale. Notice how exhaling relaxes your shoulders, chest, and stomach. Let go of all the contractions in your body...
Arch your lower back so there is a space between it and the floor or the chair. Feel the tension along your spine and back. Be sure your legs and the rest of your body are relaxed...Relax and let go...Relax the lower back, upper back, stomach, chest, shoulders, arms, face. Relax further...
Tighten your buttocks. Be sure your abdomen and the rest of your body are relaxed. Keep breathing...Relax and let go...Feel how different the sensations of relaxation are from those accompanying the tightening...
Now point your toes and feet downward to tighten your calves and the arches of your feet...Be sure you keep breathing...Relax and let go...
Curl your toes toward you to create tension along your shins and the top of your feet...Relax and let go...
Now let go more and more of each of the parts of the body: feet relax...ankles relax...calves and shins...knees and thighs... buttocks and hips...Feel the heaviness of your lower body... stomach relax...waist relax...lower back...Let go more and more... Upper back relax...chest relax...shoulders...arms...Let relaxation take over...throat relax...neck...jaws and face--all relaxed.
When you are ready, take a deep breath, sit up and gently open your eyes. Observe how you feel and how the world looks. Do you notice a difference in brightness, clarity, vividness, aliveness, depth in vision...?

TAPE 2

Get in a comfortable position. Minimally tighten your right fist so that you feel only the smallest amount of tension. Hold it at this level. Be sure you continue to breathe...Now let go and relax... Observe the difference in feelings between the right and left arm and fist...

Now minimally tighten your left fist. Hold at this level so that you just feel the tightening...Let go and relax. Let the relaxation spread through the arms and the rest of the body...

Now tighten ever so slightly the following parts of your body. (Each time tighten only to the point at which you can observe tension, where you become conscious of or can "feel" the tension. Hold the tension at that level, and be sure you tighten only the intended muscle while the rest of the body stays quiet and relaxed. Be sure you continue to breathe. Each time you let go, let those parts relax further and further.) Tighten ever so slightly your scalp...let go and relax...Your forehead and facial muscles...let go and relax...The eyes...let go and relax...The tongue, jaw, and lips...let go and relax...Let the face become smooth and soft... Let the eyes sink into their sockets...Now slightly tighten the throat and neck. Hold it...Let go and relax.

While continuing to breathe, minimally tighten the triceps. Be sure the neck, eyes, and tongue are relaxed...Let go...

Raise your shoulders to your ears minimally. Be sure the neck stays loose. Observe how the shoulders feel different from the rest of the body...Let go and relax. Feel the relaxation sinking through the body...Minimally tighten the stomach. Keep breathing ...Let go and relax...Minimally tighten the buttocks...Let go and relax. Minimally tighten the feet, calves, and thighs...Let go and relax. Let yourself reach an ever deeper level of relaxation, a calmness and serenity...

Now minimally tense every muscle in your body so that you just feel the minimum tension...jaws...eyes...shoulders...arms...chest... back...stomach...legs...Be sure you keep breathing. Feel the minimum tension in every part...Let your whole body relax. Feel a wave of calmness as you stop tensing...

Now, with your eyes closed, take a deep breath and hold it. Note all the minimum tensions...Exhale and feel the relaxation and calmness developing...Note the feeling of heaviness...

Again take a breath and hold it. Observe the tensions...Exhale and let go. Feel the relaxation developing. Breathe easily and normally so that you feel the movement in the lower abdomen...As you inhale, observe how your abdomen expands. For the next minute, observe your breath. Let the abdomen move in and out while the chest stays soft and relaxed.

Each time you inhale, think, *I am*...and each time you exhale, think,...*relaxed*. Be sure your breath moves easily and smoothly in and out with a gentle movement in the abdomen...

Feel the deeper relaxation. Feel calm, tranquil, and in control. These feelings come with deep relaxation...Notice the developing sense of inner confidence...a calm indifference to external events.

Now let's deepen the relaxation even further by mentally repeating the words *'relax'*, *'calm'*, and *'in control'* with each exhalation for the next few minutes...

Just attend to the relaxation in your body. Notice the serene, calm effect, the heavy, pleasant feelings...Make sure that no tension has crept back into your head and scalp. Smooth out your forehead, eyes, face, lips, nose, tongue, and mouth. All are relaxed. Make sure that no tension has crept back into the rest of your body. Let relaxation spread through your neck, shoulders, and arms; down your sides; through your chest, stomach, lower back, knees, shins, ankles, and toes...Let your entire body relax more and more deeply, as you repeat the words *'relax'*,*'calm'*, *'in control'*, on exhalation...

Let the entire body feel more and more relaxed. Let the feeling of relaxation, calmness and control deepen for a few minutes. Think and feel the words *'relax'*, *'calm'*, *'control'*, as you exhale...

Now develop your own personal relaxing image. Take any scene which you find especially relaxing (a warm beach, sitting in front of the fire in a log cabin on a winter evening, floating

on a raft on a mountain lake, sailing on a calm day...)and stay in your image --see it, smell it, taste it, touch it, be it. Stay focused on an image that is particularly relaxing. For the next few minutes go with the image and allow the relaxation to deepen...
Maintain the sensations of relaxation. Stretch, take a deep breath. Exhale and gently open your eyes. Observe how you feel and how you experience the world.

TAPE 3

Direct your attention to the area of your neck...Press your head back as far as it can go and feel the tension in the neck...

Hold the neck there...Be sure the rest of your body is relaxed. Continue to breathe easily...Relax and let go. Observe the letting go...Press the neck back and notice the tension...Relax and let go.. Let your neck relax...Press it back again and hold...Relax and let go...

Roll the head to the right as if to look to your right. Feel the tension shift...Be sure the jaw and tongue are loose and relaxed... Breathe easily...

Now relax and let go...bringing the head back to center...Roll the head to the left as if to look left...Hold it there and feel the tension in the neck...Hold...Now let go...

Relax and let go bringing the head back to the front...Now press your chin against your chest keeping the jaw muscles loose. Press the head forward more feeling the muscles in the back of the neck becoming tense...Let go...Bring the head back to a normal position letting all the neck muscles relax...Relax and let go...breathing easily...

Let all the muscles in your neck, around from front to back, right and left release and let go...Let your head sink down, feeling a little bit heavier with each out-breath.

Let your whole body relax more...For the next few minutes, inspect your body. If you locate any area of tension, tighten that area and let go... and relax.

Raise your shoulders to your ears. Keep the neck muscles loose. Hold it and observe how the shoulders feel different from the rest of the body...Let go and relax. Feel the shoulders relax...Continue to breathe easily...Raise the right shoulder to the right ear. Keep the head looking straight and the neck muscles relaxed...Hold the tension and notice the difference between the right and left shoulders...Let go and relax...Allow both shoulders to feel loose and relaxed...Now lift the right shoulder up to the ear...hold the tension there...comparing the left to the right shoulder...Relax and let go...Press both shoulders back feeling the pressure against the backrest...Keep the neck muscles loose ...notice the difference between the tension levels in the neck and the shoulders...Relax and let go...Let both shoulders rest easily...Now pull both shoulders forward as far as possible...Feel the tension in the shoulders...Relax and let go...Check the rest of your body for tension...Let your whole body relax...

Now tighten ever so slightly the following parts of your body. (Each time tighten only to the point at which you can observe tension.) Tighten ever so slightly the muscles in the back of the neck...The rest of the body stays quiet and relaxed...Let go and relax...

Slightly tighten the right shoulder...Hold the minimal tension level comparing the feeling with that of the relaxed shoulder... Relax and let go...Both shoulders are loose...

Slightly tighten the left shoulder...tighten only the left shoulder until you can 'feel' the tension...Be sure to continue to breathe. Relax and let go...

Now tighten all the neck and shoulder muscles as hard as you can...hold the tension...Relax and let go...Observe the sensation of letting go...Say to yourself on the inhalation '*I am*' ..., and on the exhalation,... '*in control*'.

Repeat and allow the sensation of relaxation to occur... After a few minutes, stop, relax, and stretch the body. Take a deep breath. Exhale and gently open your eyes.

TAPE 4

Get comfortable and let your body relax and rest. For the next few minutes, review the previous sensations of learned relaxation. Relax all over. Allow a pleasant leaden heaviness to develop. Allow the comfortable sensations of warmth to flow through your entire body... Feel the calmness of being enveloped by restfulness...heaviness...and warmth, so that nothing can disturb you...Feel the inner restfulness deepening, and feel that, as you relax and enjoy these sensations, you will gain a sense of strength and control from the inner restfulness... Feel your muscles yielding and relaxing all over...Let the contractions loosen. Feel more at rest...

Let your breathing come freely and easily without any effort...Think of your blood vessels widening as you relax so that circulation improves without strain or effort...Feel the pulsing and throbbing sensations in the fingers. Again with each inhalation think, '*I am*'...and with each exhalation feel... '*in control*'. Let nothing excite you or upset you. Concentrate on the feelings of relaxation and the calmness that grows out of that relaxation. Try to surrender to the good feelings all over.

Now minimally tense every muscle in your body so that you just feel the minimum tension...jaws...eyes...shoulders...arms...chest... back...stomach...legs...Be sure you keep breathing. Feel the minimum tension in every part...Let your whole body relax. Feel a wave of calmness as you stop tensing...

Now, take a deep breath and hold it. Note all the minimum tensions...Exhale and feel the relaxation and calmness developing... Note the feeling of heaviness...

Again take a breath and hold it. Observe the tensions...Exhale and let go. Feel the relaxation developing. Breathe easily and normally so that you feel the movement in the lower abdomen...As you inhale, observe how your abdomen expands. For the next minute, observe your breath. Let the abdomen move in and out while the chest stays soft and relaxed.

Each time you inhale, think, '*I am*' ...and each time you exhale, think,...'*in control*'.Be sure your breath moves easily and smoothly in and out with a gentle movement in the abdomen.

Now hear the words '*in control*'. Think about the words '*in control*', and feel it more and more. Just let the words '*in control*' echo. Feel the pleasant feelings you associate with the words. Capture the feeling of control that comes when you relax and feel calm. Capture the feeling as you relax more.

For a few moments, observe any tension in your body. When you find tension, think about the words '*calm*', '*relaxed*', or' *in control*'. Feel the body let go and relax. Allow the sensation of relaxation to occur in that part of your body.

Now deepen the relaxation even further by mentally repeating the words '*relaxed*', '*calm*', and '*in control*' with each exhalation for the next few minutes...Just attend to the relaxation in your body. Notice the serene, calm effect, the heavy, pleasant feelings...Make sure that no tension has crept back into your head and scalp. Smooth out your forehead, eyes, face, lips, nose, tongue, and mouth. All are relaxed. Make sure that no tension has crept back into the rest of your body. Let relaxation spread through your neck, shoulders, and arms; down your sides; through your chest, stomach, lower back, knees, shins, ankles and toes... Let your entire body relax more and more deeply, as you repeat the words '*relaxed*', '*calm*', '*in control*', on exhalation...

Relax comfortably and fully...Rapidly go back into that heavy, comfortable feeling all over and feel the good sensations of warmth throughout your entire body...Sense that nothing can disturb your feeling. Recapture the inner restfulness that deepens and gives you inner strength and confidence. Feel all your muscles yielding and relaxing as you let go of contractions everywhere in your body. Let yourself feel completely at rest, with your breathing coming freely and easily...

Now develop an image of yourself in the upstairs gymnastic room. Imagine yourself preparing to practice the front salto mount over low bar. You have just set the bars and have finished chalking up, and are facing the low bar ready to start your approach. Stay in your image, see the bar, the surrounding mats on the floor, the people standing close to the bar, see the light coming in the window. For the next few minutes, go with the image you have created while

you observe your body for tension. Make sure no tension has crept back into your neck or shoulders. Let the relaxation spread and allow the feeling to deepen. Maintain the sensations of relaxation. Breathe easily and smoothly. Each time you inhale, think '*I am*' and each time you exhale, think,...'*in control*'. Remind yourself to stay fully and deeply relaxed. Use the words '*calm*', '*relaxed*', and '*in control*' when you feel tension in your body.

APPENDIX C

Rating of Unstressing Sessions

RUS

RATING of UNSTRESSING SESSIONS

Name ____________________
Date ____________________

After each session of relaxation training, describe:

a) the practice situation (your physical position, the place and time of day)

b) your level of tension before and after the session
(circle one number on the scale from 0 - 10)

Date a) Physical Position: ____

____________ Place: _______________ Time: ________________________________

Tape b) Level of tension before listening to the tape:

1 2 3 4 (circle one)

0	1	2	3	4	5	6	7	8	9	10
Most unstressed you have ever been						Most stressed you have ever been				

Level of tension after listening to the tape:

0	1	2	3	4	5	6	7	8	9	10
Most unstressed you have ever been						Most stressed you have ever been				

APPENDIX D

Skill Progressions

SKILL PROGRESSIONS - Uneven Parallel Bars

A. HS to Free back hip circle to HS on HBR (2.17)
1. Straight arm back roll extension
   (Floor)
2. HS free back hip circle to HS
   (LBR/Spotting)
3. HS free back hip circle to HS
   (LBR)
4. HS free back hip circle to HS
   (HBR/Spotting)
5. HS free back hip circle to HS
   (HBR)

B. Cast straight body to HS from front support (3.2)
1. From partial shoulder extension, push with straight arms to HS
   (Spotting/FBR)
2. Cast to 45 degrees
3. Cast to HS
   (LBR/Spotting)
4. Cast to HS
   (LBR)
5. Cast to HS
   (HBR/Spotting)
6. Cast to HS
   (HBR)

C.Front salto mount over LBR catch HBR (1.10)
1. Front salto
   (Floor)
2. Front salto from beat board over rope at 3 feet
3. Front salto from beat board onto trampoline bed covered with 8 inch mat
   (Spotting)
4. Front salto from beat board over LBR
   (Bar pad/ Spotting)
5. Front salto from beat board over LBR
   (Spotting)
6. Front salto from beat board over LBR

D. Jump to HS on LBR (1.4)
1. Jump to HS
   (Floor)
2. Jump to HS
   (FBR)
3. Jump from beat board to HS on bar
   (LBR/Spotting)
4. Jump from beat board to HS on bar
   (HBR)

E. HS Pirouette (360 degrees)(3.5)
1. HS pirouette (360 degrees)
   (Floor)
2. HS pirouette (360 degrees)
   (FBR/Spotting)
3. HS pirouette (360 degrees)
   (FBR)

4. HS pirouette (360 degrees)
    (SLBR)
5. HS pirouette (360 degrees)
    (LBR)

SKILL PROGRESSIONS - Balance Beam

F. Backward extension roll to HS (6.7)
1. Bent arm back extension roll on line
    (Floor)
2. Bent arm back extension roll
    (LBM/Beam pad)
3. Bent arm back extension roll
    (LBM)
4. Bent arm back extension roll
    (HBM/Spotting)
5. Bent arm back extension roll
    (HBM)

G. Swing to HS from straddle "L" sit (1.42)
1. Isometric hold with shoulders at 45 degree angle
2. Swing up to 45 degrees
3. Cast to HS
    (MBM/Spotting)
4. Cast to HS
    (MBM)
5. Cast to HS
    (HBM/Spotting)
6. Cast to HS
    (HBM)

H. Front salto mount on end of beam (1.28)
1. Front salto on line
    (Floor)
2. Front salto from beat board to box horse
3. Front salto from beat board onto beam
    (MBM/Beam pad/ Spotting)
4. Front salto from beat board onto beam
    (HBM/Beam pad/ Spotting)
5. Front salto from beat board onto beam
    (HBM/Spotting)
6. Front salto from beat board onto beam
    (HBM)

I. Jump to HS on side of beam (1.36)
1. Jump to HS
    (Floor)
2. Jump to HS
    (LBM)
3. Jump from beat board to HS on beam
    (HBM/Spotting)

4. Jump from beat board to HS on beam
   (HBM)

J. HS Pirouette (360 degrees) from side HS (1.44)

1. HS pirouette (360 degrees)
   (Floor)
2. HS pirouette (360 degrees)
   (LBM/Spotting)
3. HS pirouette (360 degrees)
   (LBM)
4. HS pirouette (360 degrees)
   (MBM)
5. HS pirouette (360 degrees)
   (HBM)

ABBREVIATIONS AND MEASUREMENT SPECIFICATIONS OF EQUIPMENT

The environmental setting including type of apparatus and learning aids are specified in parentheses below each progression. The number following each skill corresponds to the skill number as listed in the 1979 F.I.G. Code of Points.

Box Horse	(3'3" off floor)
Floor	Skill executed on floor
HS	Handstand
Trampoline	(3'6" off floor)
45 degrees	45 degree angle above the horizontal
LBM	Low beam (1'1" off floor)
MBM	Medium beam (3' off floor)
HBM	High beam (4' off floor)
FBR	Floor bar (1' off floor)
LBR	Low bar of uneven parallel bars (4'11" off floor)
SLBR	Single low bar (4'11" off floor)
HBR	High bar (7'6" off floor)

APPENDIX E

Stress Ratings of Progressions

(SARP)

Dear Gymnast:

This questionnaire is part of a research study being done at The University of Alberta, Edmonton, Canada.

Please attempt to answer each question as honestly and sincerely as you can. One of the responses should fit your answer to each item. Please do not leave any answers blank.

All information from these questionnaires is confidential and will be used for research purposes only.

There are three parts to the questionnaire:

Part A: Personal information (Name, age, etc.)

Part B: On each of 10 selected skills, you are asked to choose a response that explains the learning stage you are at on that particular skill.

Part C: Stress level you experience when attempting to perform each of the 4 - 6 progressive stages specified for each skill.

All abbreviations used in this questionnaire are listed on the last page of the questionnaire package.

Your cooperation is sincerely appreciated.

Susan Rouse

Ph.D. graduate student

University of Alberta

Part A

Name ____________________________________

Age __________________

School/Club you compete with ____

City ____________________________________

Level of Competition (Check any that are applicable)

__ Collegiate

__ High School

__ Jr. High School

Club level (Canadian):

__ Argo

__ Tyro

__ Novice

__ Open

__ "A" level

__ "B" level

__ Pre-Elite: 1 2 3

__ Elite: 1 2 3

__ Other (Please explain)

Club level (American):

__ Class III

__ Class II

__ Class I

__ Elite

__ Compulsories only

__ Optionals only

__ Other (Please explain)

Part B

This part examines what stage of learning you are at on 10 selected skills on balance beam and uneven parallel bars.

Each skill is listed on the left.

At the top of the following page, there are six response categories (A to F) ranging from:

A - "never tried this skill", to

F - "can consistently perform this skill with the beam or bars at regulation height and without padded equipment or spotters on 7 out of 10 trials".

Instructions: Choose the category (A, B, C, D, E or F) which describes your own personal performance level on each of the 10 skills.

Place the letter of your response in the blank on the right following each skill.

Response Categories:

A - I have never tried this skill.

B - I have tried this skill 1 or 2 times.

C - I have consistently worked on this skill with padded equipment, extra mats and/or a spotter.

D - I have tried this skill without any extra mats, pads or spotters, but I cannot perform the skill consistently.

E - I can correctly perform this skill without extra mats, pads or spotters on less than 7 out of 10 trials.

F - I can consistently perform this skill with the beam or bars at regulation height and without padded equipment or spotters on at least 7 out of 10 trials.

<u>Skill</u> ______________________________ <u>Response</u>

(Choose from response categories A through F)

<u>Uneven Parallel Bars</u>

1. HS to free back hip circle to HS on HBR. . . . . __
2. Cast straight body to HS from front support on HBR . . . . __
3. Front salto mount over LBR catch HBR . . . . __
4. Jump with straddle from LBR to HS on HBR 1/2 pirouette . . . . __
5. HS pirouette (360 degrees) on LBR. . . . . __

<u>Balance Beam</u>

6. Backward extension roll to HS . . . . __
7. Swing to HS from straddle "L" sit . . . . __
8. Front salto mount onto end of beam . . . . __
9. Jump with straddle to HS on side of beam 1/2 pirouette . . . . __
10. HS pirouette (360 degrees) from side HS . . . . __

<u>Part C</u>

On the following pages, the 10 skills from Part B are listed. Under each skill are 5 or 6 progressions designed to help the gymnast learn the skill.

Please rate each progression for each skill according to the 10 point stress scale on the right.

<u>Stress</u> is defined as "*your emotional state or feelings of nervousness or tenseness when you are preparing to perform a gymnastic skill*".

"What level of stress do you feel when attempting to perform each of the following progressions?"

The stress level scale denotes two numbers for each level of stress.

1 & 2 are *low* stress levels

3 & 4 are *moderately low* stress levels

5 & 6 are *moderate* stress levels

7 & 8 are *moderately high* stress levels

9 & 10 are *high* stress levels.

Circle <u>one</u> <u>number</u> which corresponds to your stress level for each progression.

Skill Progressions - Uneven Parallel Bars

Stress Level

A. HS to Free back hip circle to HS on HBR (2.17)

1. Straight arm back roll extension (Floor) — 0 1 2 3 4 5 6 7 8 9
2. HS free back hip circle to HS (LBR/Spotting) — 0 1 2 3 4 5 6 7 8 9
3. HS free back hip circle to HS (LBR) — 0 1 2 3 4 5 6 7 8 9
4. HS free back hip circle to HS (HBR/Spotting) — 0 1 2 3 4 5 6 7 8 9
5. HS free back hip circle to HS (HBR) — 0 1 2 3 4 5 6 7 8 9

B. Cast straight body to HS from front support (3.2)

1. Cast to 45 degrees on LBR — 0 1 2 3 4 5 6 7 8 9
2. Cast to HS (LBR/Spotting) — 0 1 2 3 4 5 6 7 8 9
3. Cast to HS (LBR) — 0 1 2 3 4 5 6 7 8 9
4. Cast to HS (HBR/Spotting) — 0 1 2 3 4 5 6 7 8 9
5. Cast to HS (HBR) — 0 1 2 3 4 5 6 7 8 9

C.Front salto mount over LBR catch HBR (1.10)

1. Front salto (Floor)	0 1 2 3 4 5 6 7 8 9
2. Front salto from beat board over rope at 3 feet	0 1 2 3 4 5 6 7 8 9
3. Front salto from beat board onto trampoline bed covered with 8 inch mat (Spotting)	0 1 2 3 4 5 6 7 8 9
4. Front salto from beat board over LBR (Bar pad/ Spotting)	0 1 2 3 4 5 6 7 8 9
5. Front salto from beat board over LBR (Spotting)	0 1 2 3 4 5 6 7 8 9
6. Front salto from beat board over LBR	0 1 2 3 4 5 6 7 8 9

D. Jump with straddle to HS on HBR (1.4)

1. Jump with straddle to HS (Floor)	0 1 2 3 4 5 6 7 8 9
2. Jump with straddle to HS (FBR)	0 1 2 3 4 5 6 7 8 9
3. Jump with straddle from beat board to HS on bar (LBR)	0 1 2 3 4 5 6 7 8 9
4. Jump with straddle from LBR to HS on bar (HBR)	0 1 2 3 4 5 6 7 8 9
5. Jump with straddle from LBR to HS 1/2 pirouette (HBR)	0 1 2 3 4 5 6 7 8 9

E. HS Pirouette (360 degrees)(3.5)

1. HS pirouette (360 degrees) (Floor)	0 1 2 3 4 5 6 7 8 9
2. HS pirouette (360 degrees) (FBR/Spotting)	0 1 2 3 4 5 6 7 8 9
3. HS pirouette (360 degrees) (FBR)	0 1 2 3 4 5 6 7 8 9
4. HS pirouette (360 degrees) (SLBR)	0 1 2 3 4 5 6 7 8 9
5. HS pirouette (360 degrees) (LBR)	0 1 2 3 4 5 6 7 8 9

Skill Progressions - Balance Beam

	Stress Level
F. Backward extension roll to HS (6.7)	
1. Bent arm back extension roll on line (Floor)	0 1 2 3 4 5 6 7 8 9
2. Bent arm back extension roll (LBM/Beam pad)	0 1 2 3 4 5 6 7 8 9
3. Bent arm back extension roll (LBM)	0 1 2 3 4 5 6 7 8 9
4. Bent arm back extension roll (HBM/Spotting)	0 1 2 3 4 5 6 7 8 9
5. Bent arm back extension roll (HBM)	0 1 2 3 4 5 6 7 8 9
G. Swing to HS from straddle "L" sit (1.42)	
1. Straddle press to HS (Floor)	0 1 2 3 4 5 6 7 8 9
2. Swing up to 45 degrees from straddle "L" sit	0 1 2 3 4 5 6 7 8 9
3. Cast to HS (MBM/Spotting)	0 1 2 3 4 5 6 7 8 9
4. Cast to HS (MBM)	0 1 2 3 4 5 6 7 8 9
5. Cast to HS (HBM)	0 1 2 3 4 5 6 7 8 9

H. Front salto mount on end of beam (1.28)

1. Front salto on line (Floor)	0 1 2 3 4 5 6 7 8 9
2. Front salto from beat board to box horse	0 1 2 3 4 5 6 7 8 9
3. Front salto from beat board onto beam (MBM/Beam pad/Spotting)	0 1 2 3 4 5 6 7 8 9
4. Front salto from beat board onto beam (HBM/Beam pad/ Spotting)	0 1 2 3 4 5 6 7 8 9
5. Front salto from beat board onto beam (HBM/Spotting)	0 1 2 3 4 5 6 7 8 9
6. Front salto from beat board onto beam (HBM)	0 1 2 3 4 5 6 7 8 9

I. Jump with straddle to HS on side of beam (1.36)

1. Jump with straddle to HS (LBM)	0 1 2 3 4 5 6 7 8 9
2. Jump with straddle to HS (MBM)	0 1 2 3 4 5 6 7 8 9
3. Jump with straddle from beat board to HS on beam with 1/2 pirouette (HBM/Spotting)	0 1 2 3 4 5 6 7 8 9
4. Jump with straddle from beat board to HS on beam (HBM)	0 1 2 3 4 5 6 7 8 9
5. Jump with straddle from beat board to HS on beam with 1/2 pirouette (HBM)	0 1 2 3 4 5 6 7 8 9

J. **HS Pirouette (360 degrees) from side HS (1.44)**

1. HS pirouette (360 degrees) (Floor)	0 1 2 3 4 5 6 7 8 9
2. HS pirouette (360 degrees) (LBM/Spotting)	0 1 2 3 4 5 6 7 8 9
3. HS pirouette (360 degrees) (LBM)	0 1 2 3 4 5 6 7 8 9
4. HS pirouette (360 degrees) (MBM)	0 1 2 3 4 5 6 7 8 9
5. HS pirouette (360 degrees) (HBM)	0 1 2 3 4 5 6 7 8 9

APPENDIX F

Post-Research Questionnaire

Dear

The following questions are designed to communicate to me your feelings and reactions towards the research in which you have just taken part and completed. In-depth responses are encouraged wherever you feel they are appropriate. There are no right or wrong answers. Thus, please feel free to express your honest opinion.

All comments of any kind are encouraged and will be kept confidential.

Thank you for the time you have given to make this research possible.

(Appendix F_1: For experimental subjects)

A. What is your overall feeling about:

1. the eight weeks of unstressing training (the 4 tapes):

2. the laboratory sessions:

3. the unstressing tapes:

4. the Tuesday/Thursday gym sessions:

B. Did the unstressing training affect you outside of the laboratory? Explain.

C. General Comments:

(Appendix F_2: For modified-experimental subjects)

A. What is your overall feeling about:

1. the laboratory sessions:

2. the Tuesday/Thursday gym sessions:

B. General Comments: